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Producing Cores in Quantities

Specially Designed Machine Produces Slender 3-Inch Cores for Textile Machine Castings at the Rate of from 8000 to 10,000 Per Week— Output Equals That of Six Coremakers

BY HERBERT R. SIMONDS

NEW plants and a rapidly changing design of manufactured products are so much the rule in the industrial world today that it is interesting now and then to find a plant having the history of the romantic period before the Civil war clinging to its portals, and with a stabilized product which has changed but little in several decades.

Such is the plant of the New England Butt Co., Providence, R. I., and such is its product, namely braiding machines. This company enjoys the distinction of being one of the oldest manufacturing companies to operate continuously under one name. The peculiar condition exists that although the original name of the company has been kept, the name signifies a product which no longer is manufactured by this company. The company was organized in 1842 to manufacture butts or hinges and builders' hardware. The company was called the New England Butt Co., and was organized in 1853 as such.

The inventive genius of its early organizers soon carried the activities of the company into many specialized fields. Various kinds of machines were manufactured at different times, but the demand for braiding machines soon carried this product ahead, and recently the company has specialized almost exclusively in this branch of the textile industry. Although highly ingenious, nevertheless these machines are comparatively simple in construction, the principle of their operation having remained the same for nearly half a century.

A braid is formed by crossing a number of strands diagonally in such a way that each strand passes alternately over and under one or more of the other strands. Each bobbin is mounted on a carrier which travels in and out among the other carriers as it completes its circuit around the bed of the machine. Since the bobbins must encircle each other, they cannot be fastened rigidly to any rotating device. This peculiar requirement in the operating mechanism constitutes the essence of the braiding machine design. A typical braiding machine manufactured by this company is shown in Fig. 1. The principle of its operation resembles the maypole dance of youthful memory.

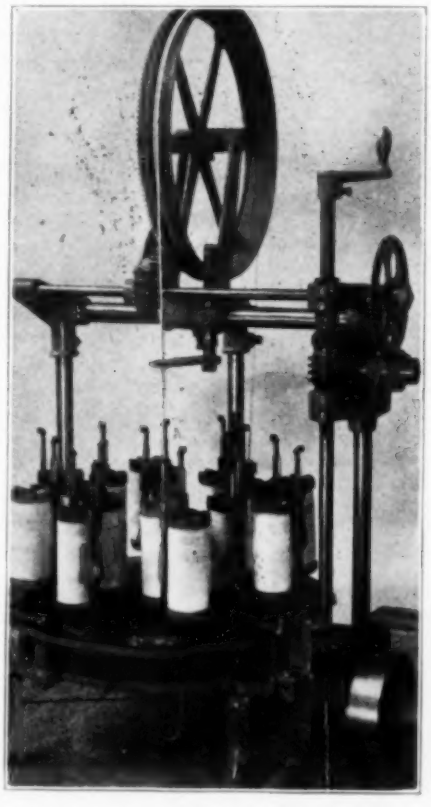


FIG. 1—CAST IRON ENTERS EXTENSIVELY INTO THE RELATIVELY SIMPLE CONSTRUCTION OF BRAIDING MACHINES

A typical New England Butt Co. machine is constructed with two plates between which a train of gears operates. These gears have flanges or horns at the top which engage the bottom end of the bobbin carriers. The top plates are ground accurately to gage and the runs or grooves in which the carriers travel also are ground thus offering the least possible amount of friction. The carriers are ground and must pass a rigid inspection. Each carrier is made to fit snugly on the top plate groove, by which it is guided, and to extend below this plate in the form of a lug which engages the horns of the horn gears, by which it is carried around the machine.

The bobbin of the braiding machine is called upon to do many things. It must move along the groove in the top plate easily. It must remain vertical when propelled at the lower end. It must carry the bobbin of yarn and present suitable tension for this yarn at all times throughout its travel. It must have means whereby the machine is stopped in case the yarn breaks or runs out.

FIG. 2—THE MULTIPLE CORE BOXES ARE FILLED WITH SAND FROM A SUPPLY ON THE BENCH AND THEN JOLTED ON A SMALL AIR OPERATED MACHINE SET CLOSE TO THE BENCH

From this it may be seen that the carrier is an important factor in the construction of a braiding machine.

Braiding machines are used for a great variety of work. In addition to the familiar cloth braids for clothing purposes, some of which are a foot or more in width, braided coverings are used extensively in the electrical field for insulating and protecting wires. These machines are used to make clothes and sash cords. Recently the New England Butt Co. turned out several machines for braiding fine wire for aerial leads in radio work.

Vary in Size

The path taken by each carrier may be better understood after examining Fig. 4. The little fillets here shown holding the circular piece in place are removed in the machine so that the paths are unobstructed. These machines, while varying in size and capacities, are standardized to a large extent. For this reason specialized equipment and the economies coincident with repetition work have been made possible throughout this plant. The capacity of the foundry is larger than required for making parts for braiding machines so that some jobbing work is done and heavy special rolls are produced.

The building housing the foundry is an old structure remodeled to give additional light and head room. Since the same jobs have continued year after year

FIG. 3—MOLDS ARE MADE ON SQUEEZER MACHINES AND THE SMALL CORES WHICH ARE MADE RAPIDLY BY MACHINE MUST BE PLACED IN THE MOLDS BY HAND

in the foundry, it has been possible to develop molding operations in individual cases to a point far beyond the general convenience of old foundries. Often one molder will produce one particular kind of casting for a number of years, thus leading to unusual skill and facility in handling this particular work.

Recently the core room has been the subject of considerable study and successful methods of reducing labor costs have been instituted. Nearly all parts entering into the manufacture of the braiding machines are castings, and their design is such that a large number of

FIG. 4—PATTERN, COPE AND DRAG FOR THE TOP PLATE THE GREEN SAND SERPENTINE CORE FORMS A GUIDE FOR THE BOBBIN

castings are required. Each bobbin carrier has a small weight which gives tension to the yarn or other material which is to be braided. These weights are cored with thin long cores which are difficult to make. From 8000 to 10,000 carriers are produced at the Providence plant in a week, and these require from 8000 to 10,000 weights and in turn the same number of cores. These cores are practically alike, so that 80 per cent of the production could be taken care of with two or three different corebox designs.

Until recently, the production of these weight cores required six girls. A common corebox was used and the cores were made rapidly by hand, although only two or three at a time. Now one man easily handles the entire production. The change was brought about by using a core machine designed by J. G. Aldrich, president of the company, and built and perfected by the foundry superintendent and others in the shop. The machine is relatively simple and its successful operation is due in a large part to the accuracy in the construction of the coreboxes. A corebox is shown tipped up on edge in Fig. 6. With this box 90 cores are produced at a time. The completed cores ready for baking may be seen just below the box in the illustration.

Directly to the left of the core machine and forming a part of the equipment is an air operated jolt table which is used for filling the corebox. This is shown in Fig. 2. The operator is shown about to jolt the box which loosely is filled with core sand. The coremaker first places the corebox on the jolt table, which previously has been swept clean. He fits a wooden frame work around the box which extends about one half inch above the top surface, thus leaving space to fill in the sand.

The sand mixing bin is at his left. A small box, directly in front of the coremaker, contains a quantity of properly mixed sand, and it is this that he uses in filling the core box. Two or three scoopsful fill the space on top of the box to the top of the wooden frame. This is jolted several times, another scoopful is added and jolted some more. The wooden frame is removed and the superfluous sand is scraped off roughly, thus completing the work of filling the corebox. This leaves a rough upper surface on the cores, but as this rough end is placed in a core print in the mold, a flat surface is unnecessary.

The filled core box is transferred to the machine shown in Figs. 5 and 6. The plate or bed is raised to the position shown in Fig. 5 to receive the corebox, which is set with the same surface against the plate as previously was against the smooth plate of the jolt machine. The box fits over small dowels which hold it in position accurately during the drawing process. These dowels and holes are shown clearly in Fig. 6. With the box in place and fitting snugly against the plate, the air vibrator is started and the operator, using a wooden mallet with one hand to tap the box, gradually lowers the table by turning the lever shown at the right with the other

hand. This results in 90 perfectly made slender cores standing on end on the table and ready to be placed in the oven. The core ovens are directly back of the operator.

However, the development of this method has not been without setbacks. At first the coreboxes were made with straight impressions through the steel so that each core had exactly the same cross section throughout. Difficulty was encountered in getting clear draws, which meant a loss of time and much inconvenience, for if one core was imperfect the whole box was tied up while this individual space was cleaned thoroughly. Boxes using taper holes then were tried and immediately were successful. However, the designing engineers did not want the castings to have a taper hole, so that gradually the taper was reduced, and now on a 3-inch core the taper is but 0.001-inch.

It has been found economical to put the best workmanship into the construction of these multiple coreboxes. A highly polished surface surrounding the cores is necessary for the most successful operation, the polish being secured by hand rubbing or lapping. Under ordinary conditions the box is used over and over again with practically no necessity for cleaning other than the occasional use of a blast of air. Occasionally the boxes are taken apart and repolished. The box is made of strips bolted together which makes this comparatively simple.

In addition to the cores for the weights, many other cores of various designs are required, and gradually the methods for making these cores are being altered to conform with the procedure previously described. However, some of the complicated cores must be made in individual coreboxes.

Many interesting operations take place on the molding floor of the foundry. The mold for the top plate of a standard braidinf machine is shown in Fig. 4. This plate must be free absolutely from warping, as it furnishes a guide for the bobbin carriers. To overcome the tendency to warp, the mold is poured from two ladles at once, each ladle supplying half of the required metal. The two main gates may be seen in the cope. The gates feed the casting through a large number of runner gates spaced radially around the inner edge of the plate. To prevent erosion when the hot metal strikes the sand of the mold, each gate is located directly opposite one of the small openings. These openings are left merely to hold the circular pieces, called quoits, in place during the process of casting. After the casting is taken from the mold these supporting lugs are broken and in the furnished machine the quoits are held in the same position occupied in the original casting by square section bolts, one at the center of each quoit.

It is reported that native platinum has been found in a winze started in the workings 500 feet from the surface in the Drum Lummon mine, Canada.

Molding Sash Weights

Question: Kindly inform us where we may obtain information covering the subject of end molded sash weights, particularly whether the method is patented. If the subject has been covered in THE FOUNDRY within recent years we shall appreciate your courtesy is directing our attention to specific issues.

Answer: The method to which you refer undoubtedly is that practiced by a firm in Baltimore and described in the July 15, 1922 number of THE FOUNDRY on page 601. The process of making sash weights by drawing the patterns through openings in the end of the flask is not patented. The Baltimore firm has been granted patents on a multiple corebox designed to form the eye and imprint the number on sash weight castings. The core is in the form of a plug adapted to close the end of the sand mold in which the weight is cast. It forms the eye which receives the cord and incidentally shapes the entire end of the casting.

Interesting articles describing sash weight molding methods were published in the following back numbers of THE FOUNDRY: April 15, June 1 and Aug. 1, 1921. A comprehensive series of articles dealing in detail with the many phases of the same subject began in the March 15, 1924, number and ran through several succeeding numbers. Practically every commercial method applied to either small or large production were considered in the series.

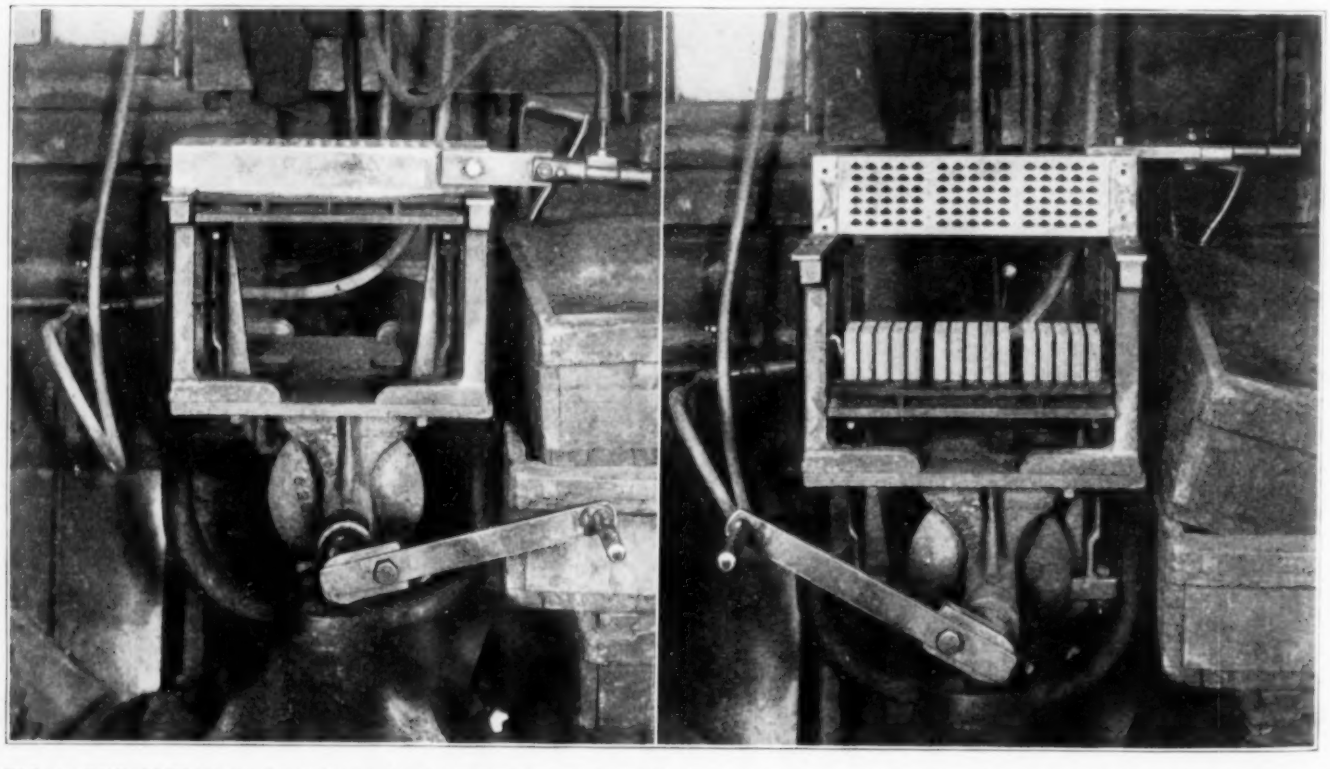


FIG. 5—THE OPERATOR GRADUALLY LOWERS THE TABLE WITH A LEVER WHILE THE AIR VIBRATOR IS OPERATING
FIG. 6—THIS EQUIPMENT PRODUCES 90 SLENDER 3 INCH CORES AT ONE TIME

Decrease in Foundries Noted

Statistics Indicate Less Number of Castings Plants in Operation in 1924 Than in 1922—Stringent Reductions in Steel and Gray Iron Shops

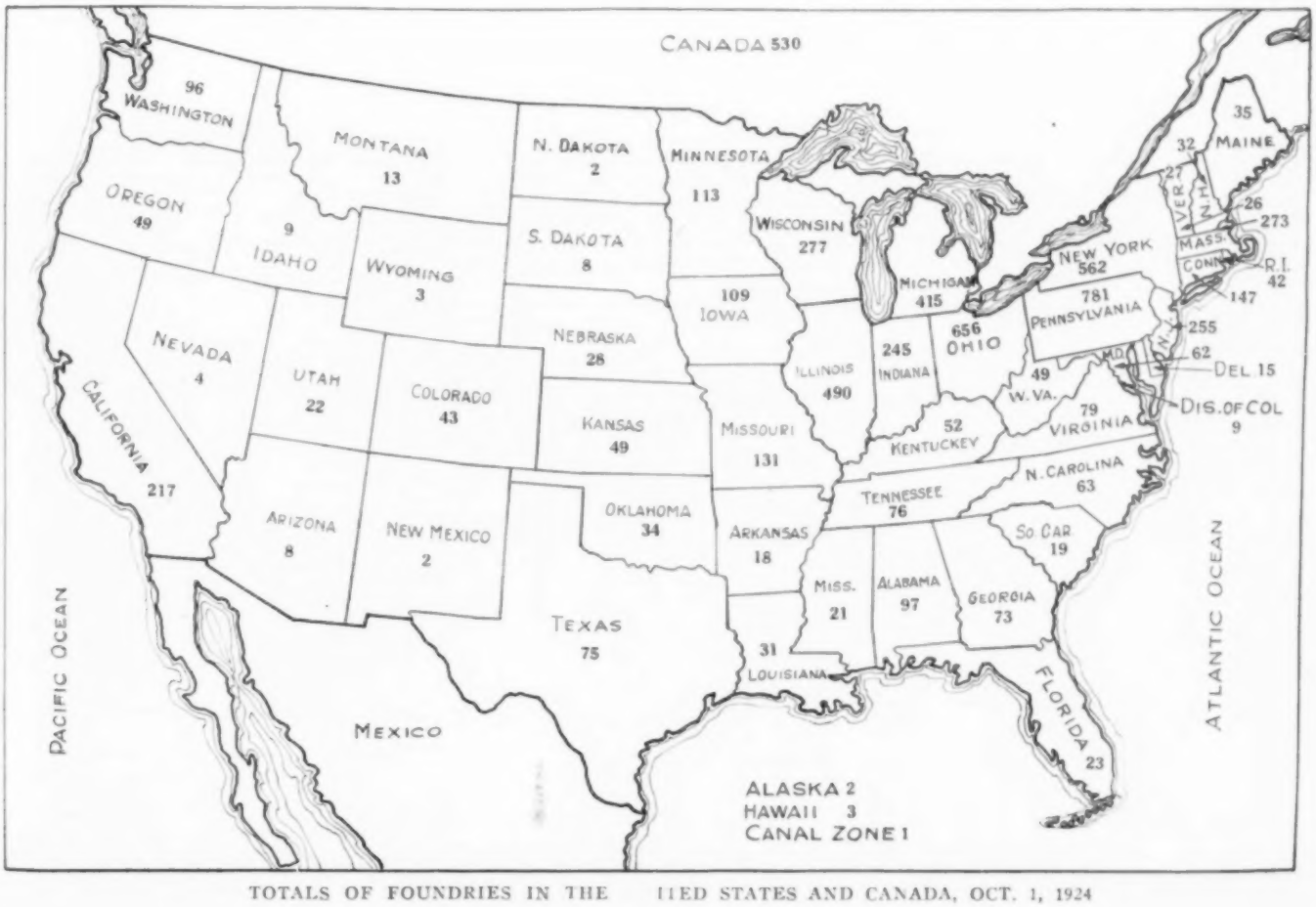
SHRINKAGE which apparently is the reflex of over-expansion during the post-war period has resulted in a decrease in the total of foundries in the United States and Canada, according to statistics compiled for THE FOUNDRY from the new edition of *Penton's Foundry List*. That this loss is in no sense alarming, but rather is a healthful measure tending to reduce an overweight condition in the industry, is the opinion of those well informed on the business outlook in castings manufacture.

The total of all classes of foundries in the United States and Canada is given as 6475 against a net of 6733 shops in 1922, giving a decrease in the number of plants in operation of 258, or 3.84 per cent. In the United States alone, 5945 foundries were reported in operation in 1924 and 6181 in 1922, giving a loss of 236, or 3.82 per cent. The proximity of these two percentages indicates that the loss in foundry capacity was due to general conditions and in no sense is attributable to geographical location or conditions within political boundaries. This further is supported by a study of the conditions in different states, where the general shrinkage has followed a similar declining curve.

It will be recalled by many who have studied the industry as a whole, that a marked increase was shown in 1922 over 1920. The upward swing of castings demand following the war had induced a feverish construction movement. In 1922, the total number of foundries in the United States and Canada had risen to the total given of 6733, while 1920 had shown 6516, the increase being 217 or 3.33 per cent.

The main divisions of the castings industry have followed the grand totals closely in showing a loss in 1924, with the exception of brass foundries, which made a gain during the past two years. The total number of gray iron foundries in the United States and Canada in 1924 is 4564, compared to 4854 in 1922, giving a loss of 290. This marks a decline of almost 6 per cent. This increased mortality among gray iron castings manufacturers has occasioned considerable concern, particularly since the growth of the automobile industry, the increased demands of the railroads, and extensive constructional and public service requirements have had a tendency to broaden the field of service of gray iron. A study of individual states demonstrates that the loss in gray iron capacity has not been limited to individual states but has been general. The east has suffered severely, but so, also, have Ohio, Michigan, Illinois and those other states possessing the large automobile centers. In the United States alone, 1924 shows a total of 4135 and in 1922, 4396 gray iron shops, giving a decrease of 261. Canada, in 1924 has 429 and in 1922 had 458 gray iron foundries. The Canadian loss is 29 or 6.35 per cent.

The total number of brass shops in the United States and Canada, together, increased from 3542 in 1922 to 3574 in



TOTALS OF FOUNDRIES IN THE ITED STATES AND CANADA, OCT. 1, 1924

TOTALS OF FOUNDRIES IN UNITED STATES AND CANADA, 1922

GRAY IRON SHOPS IN THE UNITED STATES AND CANADA, OCT. 1, 1924

MALLEABLE FOUNDRIES IN UNITED STATES AND CANADA, OCT. 1, 1924

1924. In the United States alone, the totals were 3217 in 1922 and 3265 in 1924, while in Canada they stood at 325 in 1922 and 309 this year, giving a loss instead of a gain in Canadian brass foundries. The total of exclusive brass foundries on both sides of the border stood at 1391 in 1922 and 1452 in the present year, giving a gain of 61 or 4.38 per cent. On the other hand the number of brass foundries operated as de-

Table I

Iron and Steel Foundries, 1924-1922

Total Foundries In The United States and Canada, 1924-1922	
United States and Canada, 1924	6475
United States and Canada, 1922	6733
Total loss of foundries	258
Foundries, United States, 1924	5945
Foundries, United States, 1922	6181
Loss, in United States	236
Foundries, in Canada, 1924	530
Foundries, in Canada, 1922	552
Loss in Canada	22
Gray Iron Foundries in the United States and Canada, 1924-1922	
United States and Canada, 1924	4564
United States and Canada, 1922	4854
Total gray iron decrease	290
Gray iron, United States, 1924	4135
Gray iron, United States, 1922	4396
Decrease in the United States	261
Gray iron, Canada, 1924	429
Gray iron, Canada, 1922	458
Decrease in Canada	29
Malleable Foundries in the United States and Canada, 1924-1922	
United States and Canada, 1924	229
United States and Canada, 1922	274
Decrease	45
United States, 1924	209
United States, 1922	251
Decrease	42
Canada, 1924	20
Canada, 1922	23
Decrease	3
Steel Foundries in the United States and Canada, 1924-1922	
United States and Canada, 1924	374
United States and Canada, 1922	409
Decrease	35
United States, 1924	347
United States, 1922	379
Decrease	32
Canada, 1924	27
Canada, 1922	30
Decrease	3
Electric Steel Foundries in the United States and Canada, 1924-1922	
United States and Canada, 1924	191
United States and Canada, 1922	202
Decrease	11
United States, 1924	174
United States, 1922	183
Decrease	9
Canada, 1924	17
Canada, 1922	19
Decrease	2

partments of other manufacturing establishments declined from 2151 in 1922 to 2122 in 1924. Similarly, in Canada, the exclusive brass foundries increased from 66 in 1922 to 70 in 1924, while the departmental brass shops declined from 259 in 1922 to 239 in 1924.

Malleable foundry construction met with reverses during the past two years for the first time since it began its remarkable development. In 1924, the total number of malleable foundries in the United States and Canada is given as 229, compared with 274 two years ago. This registers a decline of 45 shops or 16.4 per cent. Naturally this large percentage of loss is attributable to the comparatively small number of

Table II
Nonferrous Foundries, 1924-1922

Total Exclusive Brass Foundries and Brass Departments of Other Plants in the United States and Canada, 1924-1922

United States and Canada, 1924	3576
United States and Canada, 1922	3542
Increase	34
Total brass, United States, 1924	3267
Total brass, United States, 1922	3217
Increase	50
Total brass, Canada, 1924	309
Total brass, Canada, 1922	325
Decrease	16

Exclusive Brass Foundries in the United States and Canada, 1924-1922

United States and Canada, 1924	1452
United States and Canada, 1922	1391
Increase	61
Exclusive brass, United States, 1924	1382
Exclusive brass, United States, 1922	1325
Increase	57
Exclusive brass, Canada, 1924	70
Exclusive brass, Canada, 1922	66
Increase	4

Brass Departments of Gray Iron, Malleable and Steel Foundries in the United States and Canada, 1924-1922

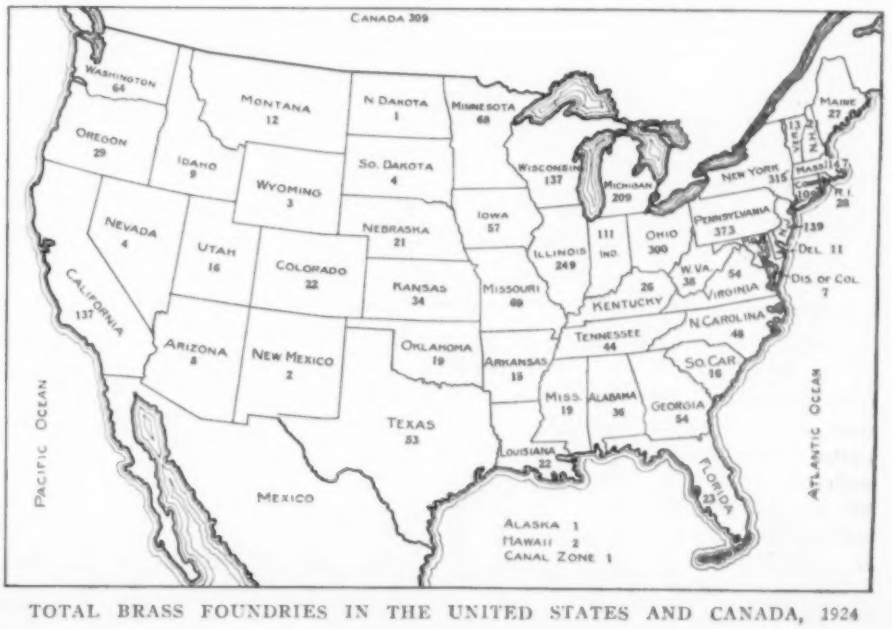
United States and Canada, 1924	2122
United States and Canada, 1922	2151
Decrease	29
Brass departments, United States, 1924	1883
Brass departments, United States, 1922	1892
Decrease	9
Brass departments, Canada, 1924	239
Brass departments, Canada, 1922	259
Decrease	20

Foundries Melting Aluminum in the United States and Canada, 1924-1922

United States and Canada, 1924	2476
United States and Canada, 1922	2753
Decrease	277
United States, 1924	2270
United States, 1922	2500
Decrease	230
Canada, 1924	206
Canada, 1922	253
Decrease	47

STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, OCT. 1, 1924

EXCLUSIVE BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, 1924



TOTAL BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, 1924

Table III

Foundries of the United States and Canada by States and Provinces, 1924 and 1922

	Total Foundries 1 24	Total Foundries 1 22	Increase or decrease in two years	Gray iron foundries 1 24	Gray iron foundries 1 22	Exclusive brass foundries 1 24	Exclusive brass foundries 1 22	Brass foundries departments of other shops 1 24	Brass foundries departments of other shops 1 22	Total brass foundries 1 24	Total brass foundries 1 22	Malleable iron foundries 1 24	Malleable iron foundries 1 22	Steel foundries 1924	Steel foundries, 1922	Foundries melting aluminum 1 24	Foundries melting aluminum 1 22	Electric steel foundries 1 24	Electric steel foundries 1 22
Alabama	97	99	−2	83	88	4	2	32	30	36	32	1	2	6	6	25	22	4	2
Alaska	2	2	....	2	2	....	....	1	1	1	1	....	....	1	1	....	....	1	1
Arizona	8	8	....	8	8	....	....	8	8	8	8	1	1	....	....	3	4	....	....
Arkansas	18	19	−1	18	18	....	1	15	14	15	15	....	....	1	1	8	8	1	1
California	217	226	−9	141	148	5	5	78	77	137	136	3	5	21	23	109	116	20	19
Canal Zone	1	1	....	1	1	....	....	1	1	1	1	....	....	1	1	1	1	....	....
Colorado	43	49	−6	31	30	11	13	11	15	22	28	....	....	4	5	17	22	1	3
Connecticut	147	187	−40	7	6	70	72	32	44	102	116	13	14	7	7	73	78	3	3
Delaware	15	16	−1	7	7	4	6	7	6	11	12	1	1	3	4	6	7	....	2
Dist. of Columbia	9	9	....	6	7	3	2	4	5	7	7	....	....	1	2	7	6	....	1
Florida	23	26	−3	21	23	2	3	21	21	23	24	1	1	1	....	21	25	1	....
Georgia	73	81	−8	65	76	5	5	44	52	54	57	....	....	1	2	37	41	1	1
Hawaii	3	4	−1	3	4	....	....	2	4	2	4	....	....	....	....	1	....	....	....
Idaho	9	9	....	....	....	....	....	9	9	9	9	....	....	....	....	8	8	....	....
Illinois	490	523	−33	311	328	131	123	118	101	249	224	32	38	25	25	174	202	11	15
Indiana	245	252	−7	175	188	50	42	61	62	111	104	15	19	11	11	88	86	3	3
Iowa	109	110	−1	1	5	12	9	45	42	57	51	1	1	6	6	44	49	3	3
Kansas	49	48	+1	44	45	4	2	30	27	34	29	2	1	1	....	29	29	1	....
Kentucky	52	55	−3	41	41	12	12	14	16	26	28	....	1	....	2	16	19	....	....
Louisiana	31	36	−5	27	2	3	7	19	20	22	27	....	....	4	3	13	16	3	1
Maine	35	38	−3	31	34	4	4	23	25	27	29	....	....	....	....	14	15	....	....
Maryland	62	60	+2	43	42	1	18	19	23	38	41	2	1	1	....	27	27	....	....
Massachusetts	273	281	−8	166	173	87	92	60	57	147	149	4	3	14	16	114	120	8	8
Michigan	415	423	−8	235	263	112	122	97	90	209	212	14	19	11	15	45	172	6	6
Minnesota	113	119	−6	84	5	21	19	47	50	68	69	1	1	7	8	55	59	3	3
Mississippi	21	22	−1	21	22	....	....	19	22	19	22	....	....	....	....	7	11	....	....
Missouri	131	143	−12	90	7	37	37	32	36	69	73	2	6	5	5	52	64	2	2
Montana	13	13	....	13	13	....	....	12	12	12	12	....	....	....	....	9	8	....	....
Nebraska	28	34	−6	24	29	3	5	18	20	21	25	....	....	1	2	18	25	1	1
Nevada	4	4	....	3	3	1	1	3	3	4	4	....	....	....	....	3	3	....	....
New Hampshire	32	31	+1	27	26	5	5	16	14	21	19	1	1	1	1	11	16	1	1
New Jersey	255	231	+24	158	154	86	67	53	52	139	113	5	6	9	7	100	94	4	1
New Mexico	2	2	....	2	2	....	....	2	2	2	2	....	....	....	....	2	2	....	....
New York	562	593	−31	350	374	153	162	162	169	315	331	23	28	18	19	233	239	9	10
North Carolina	63	74	−11	63	73	....	1	48	57	48	58	1	1	1	1	40	50	....	....
North Dakota	2	2	....	2	2	....	....	1	1	1	1	....	....	....	....	1	1	....	....
Ohio	656	683	−27	414	455	186	170	114	107	300	277	31	37	40	52	214	208	20	30
Oklahoma	34	38	−4	28	32	5	5	14	22	19	27	....	1	2	2	17	23	2	1
Oregon	49	50	−1	41	44	6	4	23	24	29	28	....	1	4	4	19	26	3	2
Pennsylvania	781	775	+6	567	574	156	130	217	213	373	343	26	28	88	93	250	235	26	30
Rhode Island	42	45	−3	22	28	18	14	10	8	28	22	1	1	1	1	23	20	1	1
South Carolina	19	20	−1	18	19	1	....	15	18	16	18	....	....	....	1	13	13	....	....
South Dakota	8	7	+1	7	6	1	1	3	4	4	5	....	....	....	....	3	4	....	....
Tennessee	6	74	+2	68	70	6	5	38	30	44	35	1	1	2	2	31	27	....	....
Texas	75	72	+3	58	59	15	13	38	38	53	51	....	....	5	4	39	39	3	2
Utah	22	22	....	20	20	1	2	15	16	16	18	....	....	1	2	13	15	1	1
Vermont	27	27	....	25	25	2	2	11	14	13	16	....	....	....	....	11	14	....	....
Virginia	79	89	−10	78	87	....	2	54	63	54	65	1	2	4	6	43	44	3	3
Washington	96	81	+15	67	65	19	13	45	40	64	53	1	1	12	10	45	44	10	9
West Virginia	49	56	−7	39	44	9	9	29	26	38	35	1	1	5	4	26	26	2	2
Wisconsin	277	310	−33	188	212	59	63	78	80	137	143	24	28	21	25	105	116	16	15
Wyoming	3	2	+1	3	1	....	1	3	1	3	2	....	....	....	....	2	1	....	....
Total in U.S.	5945	6181	−236	4135	4396	1382	1325	1883	1892	3265	3217	209	251	347	379	2270	2500	174	183
CANADA																			
Alberta	15	16	−1	12	13	3	3	12	13	15	16	....	1	....	....	12	14	....	....
British Columbia	33	31	+2	29	26	4	4	18	19	22	23	....	....	2	2	19	19	2	2
Manitoba	14	15	−1	11	12	2	2	5	6	7	8	....	....	2	1	5	8	2	1
New Brunswick	19	20	−1	15	18	2	2	11	13	13	15	....	....	....	....	8	10	....	....
Newfoundland	2	2	....	2	2	....	....	1	1	1	1	....	....	....	....	1	1	....	....
Nova Scotia	29	30	−1	27	29	....	....	22	20	22	20	4	2	1	3	12	8	1	1
Ontario	310	327	−17	247	264	44	43	121	131	165	174	13	15	10	10	112	140	5	4
Prince Edward I.	3	3	....	3	3	....	....	2	2	2	2	....	....	....	....	1	1	....	....
Quebec	102	104	−2	80	87	15	12	44	50	59	62	3	5	12	14	33	48	7	11
Saskatchewan	3	4	−1	3	4	....	....	3	4	3	4	....	....	....	....	3	4	....	....
Total in Canada	530	552	−22	429	458	70	66	239	259	309	325	20	23	27	30	206	253	17	19
Total in U. S. and Canada	6475	6733	−258	4564	4854	1452	1391	2122	2151	3574	3542	229	274	374	409	2476	2753	191	202

malleable foundries and also in a measure to the conversion of a few shops from malleable to gray iron or in some cases steel castings production. In the United States alone, the total of active malleable shops for 1924 is given as 209 and for 1922, as 251, while Canada reported three less this year, showing 23 in 1922 and 20 this year.

The total number of foundries making steel castings in 1924 is given as 374, compared with 409 in 1922 in both the United States and Canada. A loss of 32 shops is reported in the United States and 3 in Canada. Similarly the electric steel foundries decreased in number, the total for both sides of the border standing at 202 in 1922 and 191 in 1924. In the United States alone, the net loss was 9 foundries making electric steel castings.

Foundries melting aluminum showed a decrease from 2753 in 1922 to 2476 in 1924 in the United States and Canada. In the United States alone the total for 1922 was 2500 and in 1924 was 2270.

Pennsylvania again leads in the roll call of the states with a total of 781 foundries to her credit in 1924, compared with 775 in 1922. Ohio comes second, but has dropped back from a total of 683 two years ago to 656 today. Similarly, New York has lost

dropping from a total of 593 to 562, but still maintaining third place by a comfortable margin over Illinois which shows 490 shops in 1924 compared with 523 in 1922. Michigan also has lost, but not so much in proportion, the 1922 total being 423 and that of 1924, 415. Wisconsin has dropped from 310 to 277; Massachusetts from 281 to 273, but New Jersey has stepped ahead of Indiana, by increasing from 231 in 1922 to 255 in 1924, while Indiana has dropped back from 252 to 245. Washington has gone ahead from 81 to 96 in the two years, while Tennessee also shows a gain from 74 to 76. The order of states in the total number of foundries is given in Table IV.

Table IV

Roll Call of Total Foundries by States, 1922-1924

State	1924	1922
Pennsylvania	781	775
Ohio	656	683
New York	562	593
Illinois	490	523
Michigan	415	423
Wisconsin	277	310
Massachusetts	273	281
New Jersey	255	231
Indiana	245	252
California	217	226
Connecticut	147	187
Missouri	131	143
Minnesota	113	119
Iowa	109	110
Alabama	97	99
Washington	96	81
Virginia	79	89
Tennessee	76	74
Texas	75	72
Georgia	73	81
North Carolina	63	74
Maryland	62	60
Kentucky	52	55
West Virginia	49	56
Oregon	49	50
Kansas	49	48
Colorado	43	49
Rhode Island	42	45
Maine	35	38
Oklahoma	34	38
New Hampshire	32	31
Louisiana	31	36
Nebraska	28	34
Vermont	27	27
Florida	23	26
Utah	22	22
Mississippi	21	22
South Carolina	19	20
Arkansas	18	19
Delaware	15	16
Montana	13	13
District of Columbia	9	9
Idaho	9	9
Arizona	8	8
South Dakota	8	7
Nevada	4	4
Hawaii	3	4
Wyoming	3	2
Alaska	2	2
New Mexico	2	2
North Dakota	2	2
Canal Zone	1	1

Of the states which have shown a gain in the past two years, Pennsylvania registers an advance in exclusive brass foundries, in total brass foundries and in those which melt aluminum. New Jersey has gained slightly in gray iron and steel shops, and more decidedly in brass foundries of the various classifications. Washington with its increase of 15 foundries has gained in gray iron, steel, brass, aluminum and electric steel, but still reports only one malleable foundry. Tennessee has gained in brass and aluminum shops, but not in gray iron as might be expected.

In Canada, Ontario maintains her decided lead with a total of 310 shops in 1924 compared with 327 in 1922. A decrease is noted in gray iron, brass, malleable and aluminum foundries. Quebec again is second with a total of 102 in 1924, against 104 in 1922, while the other provinces take their respective place in order with the following totals for 1924: British Columbia, 33; Nova Scotia, 29; New Brunswick, 19; Alberta, 15; Manitoba, 14; Saskatchewan and Prince Edward Island with 3 each and Newfoundland, 2.

The order of states in the total number of gray iron castings plants in 1924 is as follows: Pennsylvania, 567; Ohio, 414; New York, 350; Illinois, 311; Michigan, 235; Wisconsin, 188; Indiana, 175; Massachusetts, 166; New Jersey, 158; California, 141. It will be noted that this order closely approximates that of the total number of foundries with the exception that New Jersey and Indiana exchanges places.

Pennsylvania leads in the production of electric steel castings, with Ohio and California tied for second place, and Wisconsin next. In the grand total of steel foundries, Pennsylvania is first, New York is second and Ohio is third. The order of other states in steel castings manufacture is as follows: Illinois, Massachusetts, California, Wisconsin, New Jersey and Indiana.

In the total number of brass foundries, Pennsylvania leads in 1924 with a total of 373 shops. New York is second with 315; Ohio, third with 300 and Illinois fourth with 249.

Illinois is the leading state in the production of malleable, if the total number of malleable shops governs. In 1924 that state had 32 foundries. The order of the other leading states with their total number of malleable foundries follow: Ohio, 31; Pennsylvania, 26; Wisconsin, 24; New York, 23; Indiana, 15; Michigan, 14 and Connecticut, 13.

Decided reversals are encountered in the order of leading foundry cities of the United States. Chicago still maintains the lead with a total of 200 foundries in 1924, compared with 197 in 1922. Cleveland has moved up from fourth to second place with 118 foundries noted in 1924 against 117 in 1922. New York maintains third with a total 115 this year against 129 two years ago. Detroit has dropped back from second to fourth place through having 109 shops in operation in 1924 instead of 134 as in 1922. Philadelphia still occupies fifth place with a total of 109 foundries, a gain of 12 over the total reported in 1922. Milwaukee still is sixth with 74 foundries this year, while 82 were noted in 1922. Boston and environs has seventh place with 72 shops this year, against 77 two years ago. Los Angeles has climbed up from eleventh to eighth place with a total of 70 for 1924, an increase of 10 per cent in two years. St. Louis is ninth with 68, compared with 75 two years ago, while Cincinnati comes next with 65, an increase of one. Pittsburgh has dropped from ninth to eleventh with a total of 63. The other cities having 25 or more foundries take the following order: Buffalo, Newark, N. J.; Toronto, Ont.; San Francisco; Minneapolis; Baltimore; Columbus, O.; Montreal, Que.; Toledo, O; Seattle; Indianapolis; Birmingham; Dayton, O.; Erie, Pa.; Louisville, Ky.; Denver, Colo.; Portland, Ore.; Reading, Pa.; Rochester, N. Y.; Bridgeport, Conn.; Springfield, O.; Chattanooga, Tenn.

Table V

Leading Foundry Centers of United States and Canada

	Total foundries 1924	Total foundries 1922
Chicago	200	197
Cleveland	118	117
New York	115	129
Detroit	109	134
Philadelphia	109	97
Milwaukee	74	82
Boston (greater Boston)	72	77
Los Angeles	70	63
St. Louis	68	75
Cincinnati	65	64
Pittsburgh	63	70
Buffalo	61	61
Newark, N. J.	50	44
Toronto, Ont.	49	55
San Francisco	42	42
Minneapolis	41	43
Baltimore	40	39
Columbus, O.	37	37
Montreal, Que.	37	32
Toledo, O.	36	35
Seattle	36	30
Indianapolis	34	36
Birmingham	33	32
Dayton, O.	32	37
Erie, Pa.	31	34
Louisville, Ky.	30	31
Denver, Colo.	29	32
Portland, Ore.	28	27
Reading, Pa.	28	26
Rochester, N. Y.	27	33
Bridgeport, Conn.	27	25
Springfield, O.	26	26
Chattanooga, Tenn.	26	25
Syracuse, N. Y.	24	28
Kansas City, Mo.	24	23
Worcester, Mass.	23	23
Canton, O.	22	30
Atlanta	22	24
Grand Rapids	21	24
Racine, Wis.	21	22
Oakland, Cal.	21	21
Providence, R. I.	20	22
Jersey City, N. J.	20	20
Vancouver, B. C.	19	16
Rockford, Ill.	18	22
Hamilton, Ont.	18	21
Lancaster, Pa.	17	13
Quincy, Ill.	17	17
New Haven, Conn.	16	18
Anniston, Ala.	16	17
Trenton, N. J.	16	13
St. Paul, Minn.	16	16
Moline, Ill.	15	12
Kalamazoo, Mich.	15	15
Saginaw, Mich	15	15
Waterbury, Conn.	13	16
Akron, O.	12	15

Tunnels Facilitate Handling of Material in New Foundry

By PAT DWYER

UNDER ordinary circumstances, a foundry probably is the last place to look for romance and yet in many cases if one has both opportunity and inclination to examine available records he may find romance hidden away under the armor which modern business assumes for its protection.

There is romance and romance. The kind in which a single man or a small group of men consistently bend every energy toward the consummation of an ideal along manufacturing lines, eventually may exert a profound influence on the lives of thousands. Less than 100 years ago John Studebaker packed his family and all his worldly goods into a four-horse, covered wagon which he had built himself and moved from a place near Gettysburgh, Pa., to Ashland, O. The territory at that time was known as the *West* and offered inducement to none but the most hardy pioneers.

The Covered Wagon

In 1852 one of his sons J. M., built a covered wagon at South Bend, Ind., and exchanged it for his expenses while accompanying a wagon train to the gold fields of California. He landed at Placerville with 50 cents in his pocket, but he had health and youth and was the only skilled iron and wood worker in a community that could do nothing without his services. Instead of prospecting for gold with a pick and shovel and finding little or none as many of the prospectors did, he worked steadily at the business which he understood. At the end of five years he had saved $8000. At the urgent insistence of two brothers who had remained in South Bend and who experienced financial difficulties in carrying on their business, J. M. secured his $8000 in gold nuggets in a leather belt strapped around his waist and calmly ignoring the risk entailed from this 25 pounds of ballast he joined a sailing ship and eventually arrived in New York and later in comparative safety and comfort arrived in South Bend, Ind.

Enjoys Long Career

J. M. Studebaker invested his money in the business and assumed active charge of all manufacturing operations. He saw the business grow from a small plant, manufacturing a few covered wagons a year to an establishment that exported all kinds of horse-drawn vehicles to practically every country in the world. He lived to see the gradual displacement of the horse by the gasoline propelled vehicle. He also saw the plant converted into an automobile factory and finally died at South Bend, March 16, 1917 the last of five brothers at the venerable age of 83. The general balance sheet of the Studebaker Corp. for Dec. 31, 1923 shows total assets of $122,424,280.23 and includes among other items quick assets $48,620,535.04, plants and property $53,996,468.55, good will, trade marks, etc., $19,807,276.64. In the past 13 years the corporation has sold 713,808 cars and the average number of employes on the payroll in 1923 was 21,199.

Romance to a greater or less extent enters into the lives and career of most men, but seldom does it enter to the extent which characterized the lives of the five Studebaker brothers. They practiced frugality, industry, self denial and honesty and were rewarded in a material way to an extent that falls to the lot of few men. The foregoing may or may not be of interest, but what possible bearing has it on the foundry?

Simply this, that the new foundry recently erected and placed in operation represents the final touch which the corporation has added to its immense self contained plant in South Bend and may be taken as the cap sheaf of an edifice that has grown over a period of 70 years. The foundry, itself, represents the combined thought of the corporation's engineering department over a period of 5 years. Visits of inspection were made to practically all the prominent foundries devoted to the production of automobile castings. Records of the most favorable features of each were collected, compiled, analyzed and afterward were compared in various combinations. The present condition and future possibilities of the business carefully were taken into consideration and the foundry was designed and equipped for a potential melting capacity of 600 tons of gray iron castings per day.

Covers Large Area

In accordance with the general scheme of the engineering department of the Studebaker Corp., plans for the building were prepared by Albert Kahn, Detroit. The contract for the erection of the building was undertaken and carried out by H. G. Christman Co., South Bend, Ind. With the possible exception of one other it is the largest foundry in the country devoted exclusively to

the production of gray iron castings for automobile use. The building measures 683 x 722 feet 7 inches and covers over 11 acres of ground space. The total floor area which includes upper floors at several points amounts to over 13 acres, or to be exact 575,419 square feet. Approximately 4500 tons of steel are incorporated in the frame.

One of the most distinctive features of the new foundry and one that to a certain extent places it in the two-story class, is the system of tunnels under the floor. These tunnels serve as main traffic arteries east and west and prevent congestion on the main floor. At the east end they terminate in openings through which one of the cranes in the stock yard may be hooked to the load. At the west end they terminate in openings immediately inside the wall of the cleaning room. Each opening is served by a hydraulic elevator which lifts the truck load of castings from the floor of the tunnel to the floor of the cleaning room. The relative position of the tunnels together with many of the other features which will assist the reader in gaining an accurate impression of the general shape, size and general layout of the building are shown in the accom-

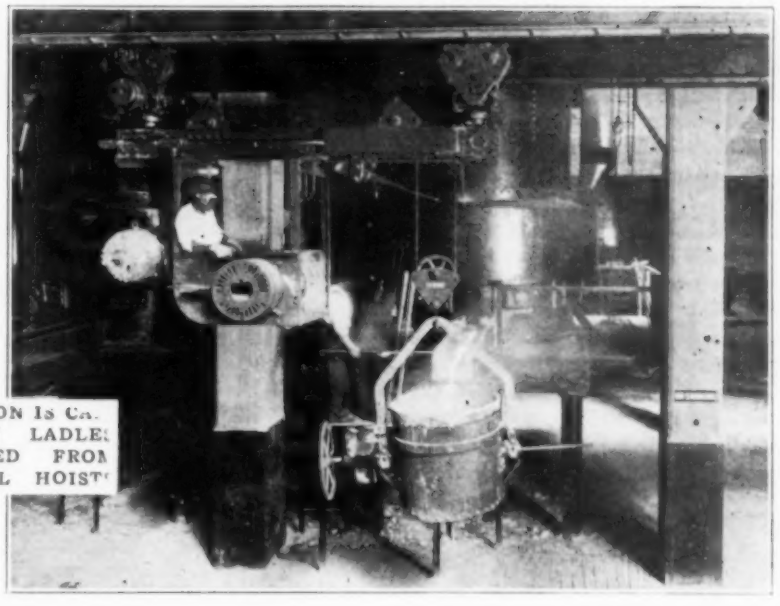


FIG. 1—IRON IS CA... RIED IN LADLES SUSPENDED FROM MONORAIL HOIST...

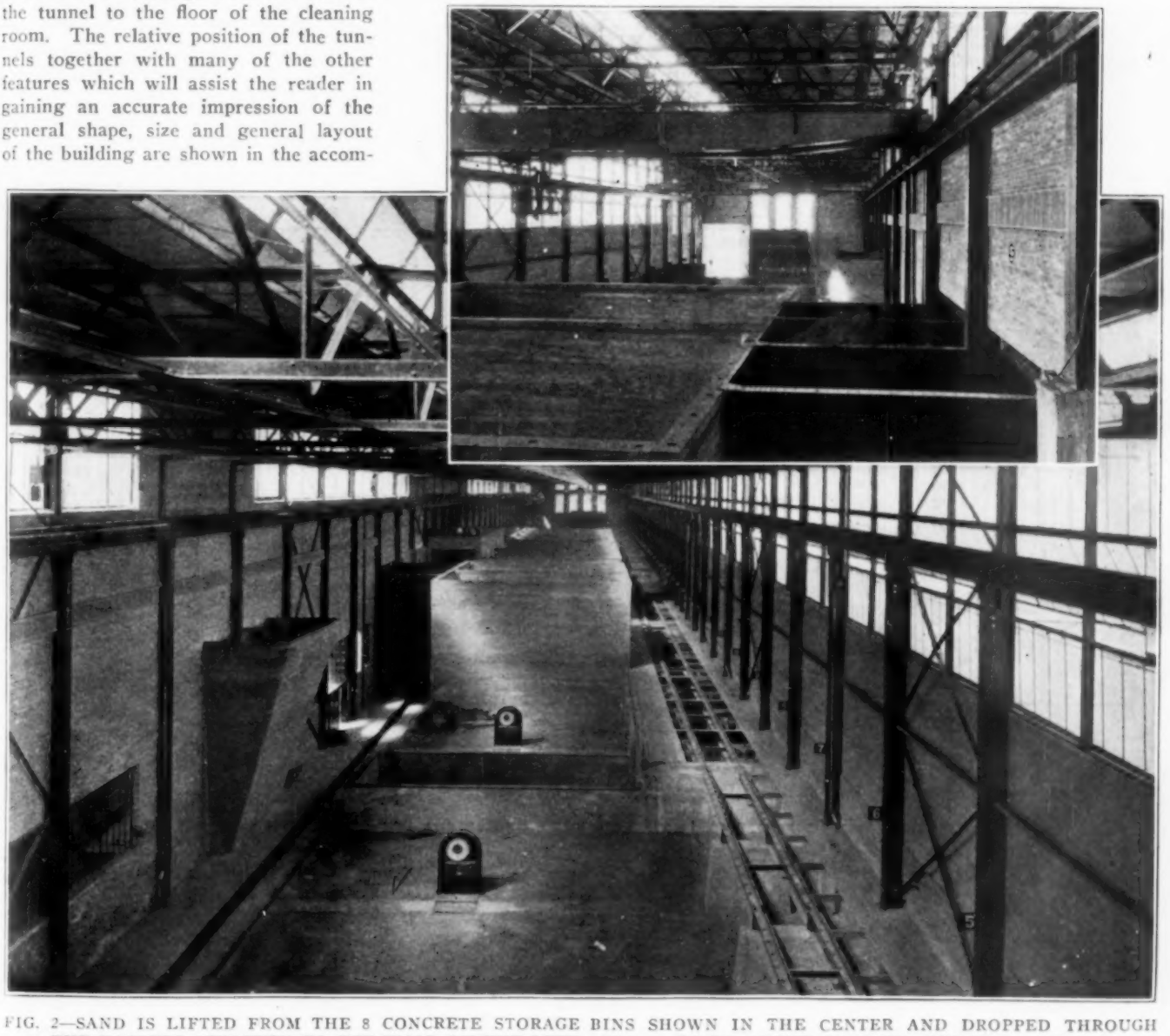


FIG. 2—SAND IS LIFTED FROM THE 8 CONCRETE STORAGE BINS SHOWN IN THE CENTER AND DROPPED THROUGH THE HOPPERS ATTACHED TO THE WALL ON THE LEFT FIG. 3—INSET ABOVE LOOKING TOWARD THE ENTRANCE TO THE MATERIAL BAY WITH THE TOP OF THE STEEL HOPPER THAT FEEDS THE FACING SAND MIXER IN THE RIGHT FOREGROUND

panying illustration, Fig. 4. The most convenient way and also the most understandable way to present a description of such a large industrial unit is to first consider the unit and the manner in which it functions as a whole then separate it into its principal component parts and take up each one more or less in detail.

The foundry has been designed and equipped to eliminate so far as possible any back tracking of material. The various departments and the sequence of operations have been arranged in such a manner that the plant virtually has been converted into a machine into which the raw material is dumped at one end and out of which the product in the shape of finished castings is shipped from the other end. This will be more readily apparent by referring to Fig. 4. Commencing at the top and reading down it will be noted that the flow of material constantly is in one direction.

All the supplies, iron, coke, sand, limestone, coal dust, blacking, core oil shipped in bulk are shunted onto an elevated track in a long continuous bay 722 feet long, 75 feet wide and 60 feet high which extends across the entire east end of the building. From this bay, which may be compared to a header on a pipe line, the material flows in a great number of streams through the numerous bays devoted to coremaking, molding and pouring the castings and finally discharges into another header at the opposite end of these numerous bays where the castings are cleaned and shipped.

Before taking up in detail the various steps in the sequence of operation, it may be of interest to examine some of the features of the plant, constructional and otherwise, which tend to facilitate operation and incidentally contribute to the pleasing appearance of the plant and the comfort and convenience of the operators. Since light and air are two of the prime requisites in any manufacturing establishment and particularly in a foundry, it is natural to find that the windows and ventilating system in this new foundry have received the consider-

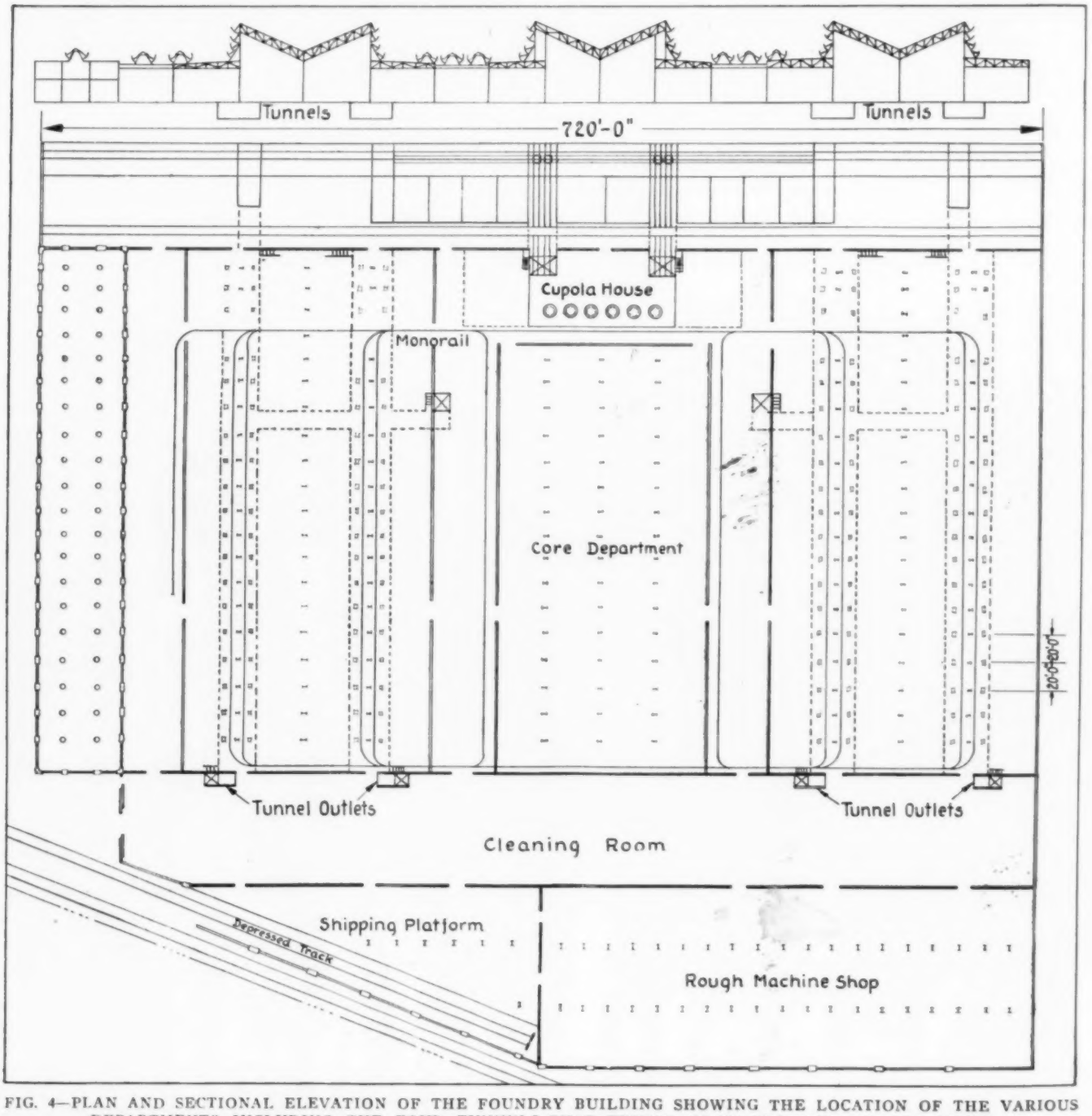


FIG. 4—PLAN AND SECTIONAL ELEVATION OF THE FOUNDRY BUILDING SHOWING THE LOCATION OF THE VARIOUS DEPARTMENTS INCLUDING THE FOUR TUNNELS THAT EXTEND FROM ONE SIDE TO THE OTHER

ation which their importance warrant. They were manufactured and installed by the Truscon Steel Co., Youngstown, O. The building with over 4½ acres or 200,000 square feet of window surface is almost enclosed in glass. It is said that a square foot of glass is available to light each three square feet of floor area.

Natural Ventilation

Several types of windows have been placed in various parts of the building. Top-hung, continuous sash is in the long runs of both the monitors and the walls. The offices are equipped with counter-balanced, sliding windows and all other portions of the structure are provided with standard-type, pivoted windows. Half a mile of windows in 400-foot sections is under push bottom control and may be opened or closed or held at any desired position between these two points by touching any desired one of three buttons. Each run of windows is controlled independently of the others so that the ventilation of the building may be adjusted to meet operating conditions on the inside and weather conditions on the outside. The roof of the building is designed to facilitate ventilation and to furnish adequate light to the entire floor. In all 66 motors are required to operate the windows. Controls from the various motors are grouped in nine stations at convenient points on the floor. The stations are kept locked and are in charge of one man who has entire charge of the ventilation of the building.

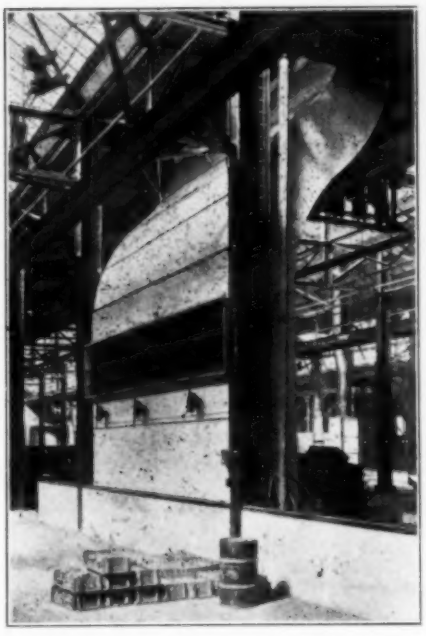


FIG. 5—ONE OF THE FRESH AIR DUCTS

In winter, natural ventilation is supplemented by a hot air system operated by seven units located in chambers under the main floor. Each chamber contains a large number of hot water coils and a fan which draws air through a suitable intake passage and discharges it throught openings in the base of the columns at the floor level. The heated air naturally rises and carries any steam or smoke that may be in the vicinity with it. The cold air intakes terminate in openings in the roof, but also are provided with openings in the side at a point about 10 feet above the floor level. These openings may be closed with adjustable shutters when the fans are drawing air through the openings in the roof. Hot water for the heater coils is distributed by a battery of powerful pumps located under the first mezzanine floor directly north of the cupolas.

Types of Floors

Wood block has been adopted for flooring material in the lower floor of the service building, in the flask storage bay at each end of the main building, in the cleaning room and in the rough machine shop. The molding floors are paved with brick with the joints filled half way with asphalt and the remainder filled with sand. A space in the center of the building 140 x 360 feet where the cores are made, dried, assembled and stored is floored with concrete surfaced with copper stone. The cores are made from an oil sand mixture easily distorted while green and for this reason it is essential that the trucks on which the core racks are loaded should travel over a perfectly smooth floor to reduce vibration to a minimum.

A two-story, service building 60 x 400 feet extends along the north side of the building and since it contains the found-

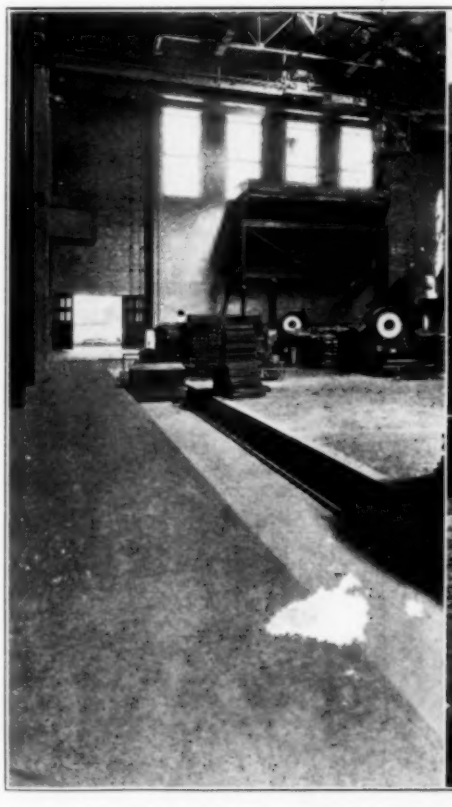


FIG. 6—REFUSE MATERIAL IS DISCHARGED THROUGH THE STEEL HOPPER AT THE EXTREME END FIG. 7—GENERAL VIEW OF THE MATERIAL BAY SHOWING THE ELEVATED TRACK AT THE LEFT, THE DEPRESSED TRACK AT THE RIGHT AND THE CONCRETE SAND STORAGE BINS IN THE CENTER

Equipment Represents Wide Range of Design

Battery trucks
E'well-Parker Co., Cleveland
Mercury Manufacturing Co., Chicago

Blowers
Spencer Turbine Co., Hartford, Conn.

Charging Cars
Whiting Corp., Harvey, Ill.

Core Machines
Champion Foundry & Machine Co., Chicago
Demmler Bros., Kewannee, Ill.

Core Ovens
Holcroft & Co., Detroit

Core Shakeout
Stoney Foundry Engineering & Equipment Co., Cleveland

Cranes
Shaw Crane Co., Muskegon, Mich.

Cupolas
Whiting Corp., Harvey, Ill.

Dust Arresters
Dust Recovering & Conveying Co., Cleveland

Elevators
Haughton Elevator & Machine Co., Toledo, O.

Molding Machines
Beardsley & Piper Co., Chicago
Davenport Machine & Foundry Co., Davenport, Iowa
Grimes Molding Machine Co., Detroit
International Molding Machine Co., Chicago.

Monorail Hoists
Shepard Crane & Hoist Co., Montour Falls, N. Y.

Sand Blast (Rotary table)
Pangborn Corp., Hagerstown, Md.

Sand Blast (Tumbling barrels)
New Haven Sandblast Co., New Haven, Conn.

Sand Cutters
American Foundry Equipment Co., New York

Sand Mixers (Core and facing)
National Engineering Works, Chicago

Scales
Toledo Scale Co., Toledo, O.

Tumbling Barrels
Whiting Corp., Harvey, Ill.

Tumbling Barrel (Continuous)
W. W. Sly Manufacturing Co., Cleveland

Windows
Truscon Steel Co., Youngstown, O.

ry office on the second floor appropriately may be selected as a starting point for a detailed description of the various units that go to make up the foundry. In addition to the office which is located next to the laboratory, the second floor of the service building has a girls' rest room, a cafeteria with accommodation for 400 people and a locker and wash room for the men. The men's room is provided with hot and cold water in bowls and showers. A special chamber is provided for drying the change of clothes. All the walls in this building are finished smooth and painted white. They present a clean, sanitary appearance and without doubt exert a salutary influence on the employes. The first story of the service building houses the pattern shop, the pattern storage, the first aid department and the store room where all small miscellaneous supplies are kept.

Incoming Raw Material

A fleet of electric battery trucks, is employed for transporting materials of many kinds around the foundry. They haul new sand from the chutes to the molding floors, facing sand from the hopper to the molding machines, cores to and from any point in the core room and castings from the cleaning room to the rough machine shop and thence to the shipping platform. They are recharged from a generating set in the north east corner of the building.

The raw material bay or stockyard shown in several of the illustrations presents many points of interest and indicates how prominent features in many foundries influenced the designers. It is spanned by three cranes, two 10-ton cranes equipped with magnets for handling the iron and one 5-ton crane equipped with a grab bucket for handling sand and rubbish. Under favorable switching conditions the cranes can handle 20 carloads a day. The unloading period for one crane on a car of pig iron is 40 minutes.

Pig iron, scrap, both iron and steel, sand and coke in car loads are shunted onto an elevated railroad track close to the east wall of this department. The iron is unloaded by the magnets and placed in stacks on the floor according to its proper classification. The sand is unloaded by the grab bucket and dropped into any one of eight concrete bins, each 26 x 41 x 37 feet, located in a row in the center of the bay. The bins extend 27 feet above and 10 feet below the ground level and have an aggregate holding capacity of 400 car loads of sand. Molding sand is stored in four bins and core sand in the remaining four. Coke shipments are specified in drop-bottom cars which are spotted over openings in the track communicating with storage chambers partly under the floor. When the car doors are released the coke is unloaded by gravity.

Molding sand is delivered to the foundry proper through two concrete chutes built on the west wall of the ma-

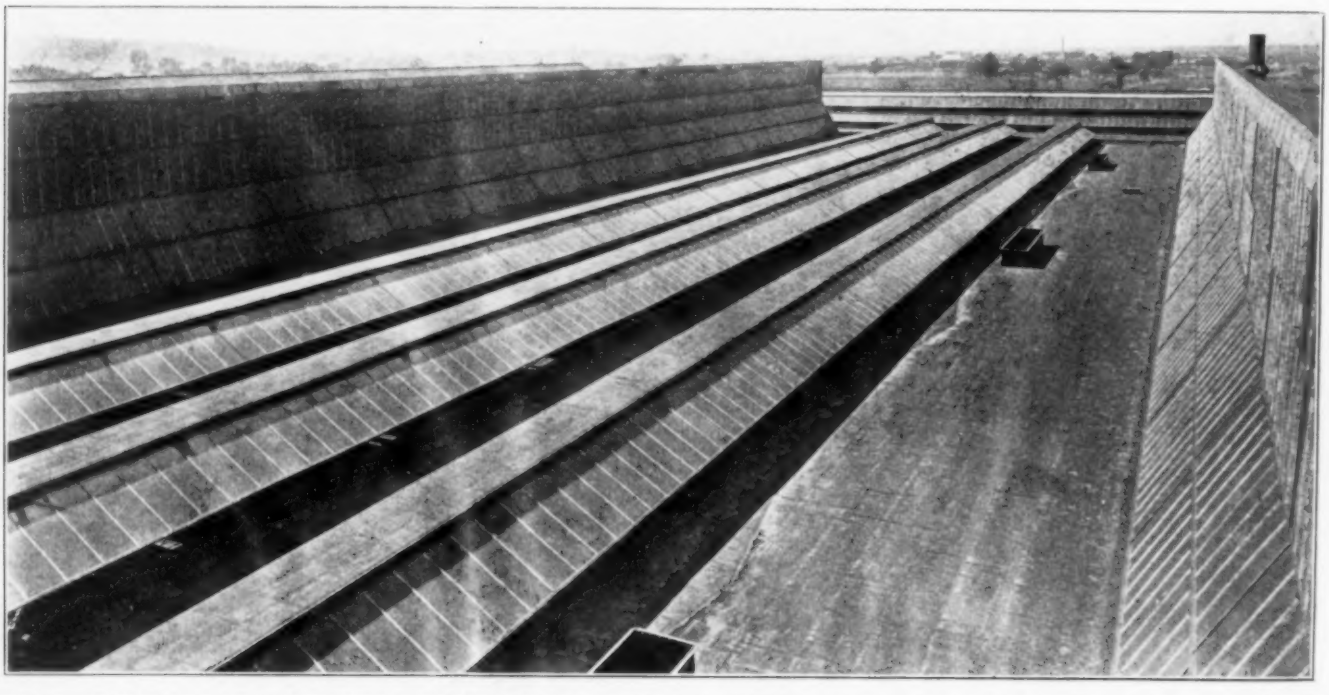


FIG. 8—STYLE OF ROOF OVER THE BUILDING PRESENTS MANY INTERESTING DETAIL FEATURES INCLUDING THE THREE OPENINGS SHOWN TO THE RIGHT THESE OPENINGS ARE THE INTAKES FOR THE FRESH AIR SUPPLY

terial bay. The sand is lifted by grab bucket from the bins and discharged into the top of the chute. It is loaded by hand into suitable buggies on the other side of the wall and hauled to any desired point by one of the electric trucks. Old sand, broken cores and refuse of all kinds delivered to the end of one of the tunnels under an opening is lifted by the crane and taken to the north wall where it is dumped into a steel hopper attached to the wall on the inside, but with its outlet on the outside. The material falls into a truck and is hauled away to the dump.

New sand for facing is dumped into a steel hopper with its intake in the material bay and its outlet in a chamber close to the cupola room. Old sand is added on the floor level and a measured quantity is placed in the boot of a bucket elevator which carries it to a point immediately below the charging deck. Here it is discharged into a long pipe which guides it into a 6-foot grinding pan. The attendant at this point adds the required amount of coal dust and after the pan has revolved for about 10 minutes, the sand is discharged onto a belt which feeds a revivifying apparatus designed by A. J. G. Rapp, Link-Belt Co., Chicago. From the revivifier the prepared sand falls onto a second horizontal belt which discharges it into a hopper with an outlet on the ground floor. From that point it is hauled away as required. The mixing apparatus is located on the first mezzanine floor. This floor also supports the blowers for the cupolas and the

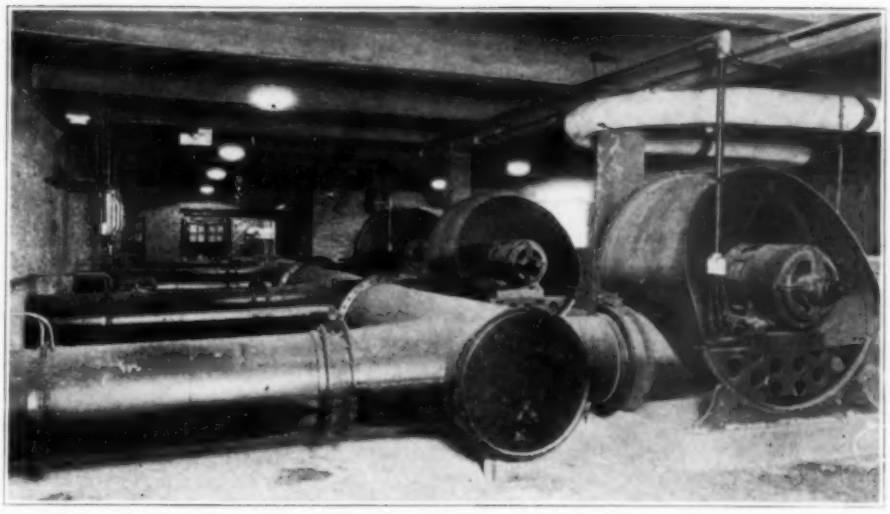


FIG. 9—THREE BLOWERS EACH CONNECTED TO AN INDIVIDUAL MOTOR DISCHARGE AIR INTO A COMMON MAIN PIPE WHICH FEEDS A BRANCH PIPE LEADING TO EACH OF THE FOUR CUPOLAS

equipment for mixing the core sand. The method for handling the core sand practically is the same as that used for the facing sand with the exception that the belt conveyor and second hopper are not employed. After the sand is prepared in the grinding pan, it is discharged into a small, two-wheel buggy which a man propels out over a long overhead platform that extends to the far end of the core room. Three of these platforms are provided, one over each row of coremaking stations. A 12-inch pipe extends from immediately above each core bench to a point flush with the overhead platform where it terminates in a rectangular hopper. The attendant dumps sand into each hopper in turn. The coremaker serves himself from the lower end of the pipe.

A narrow gage depressed track extends the full length of the materials bay close to the west wall. Short tracks at right angles extend at nine points from the depressed track to the wall supporting the elevated track on the east side of the same bay. These tracks are laid on the floor level. Nine 5000-pound scales are located on the floor, one at each short transverse track. The charging buggies are spotted on the scale and loaded. Then they are pushed on to a special electric car, the top of which is flush with the floor and

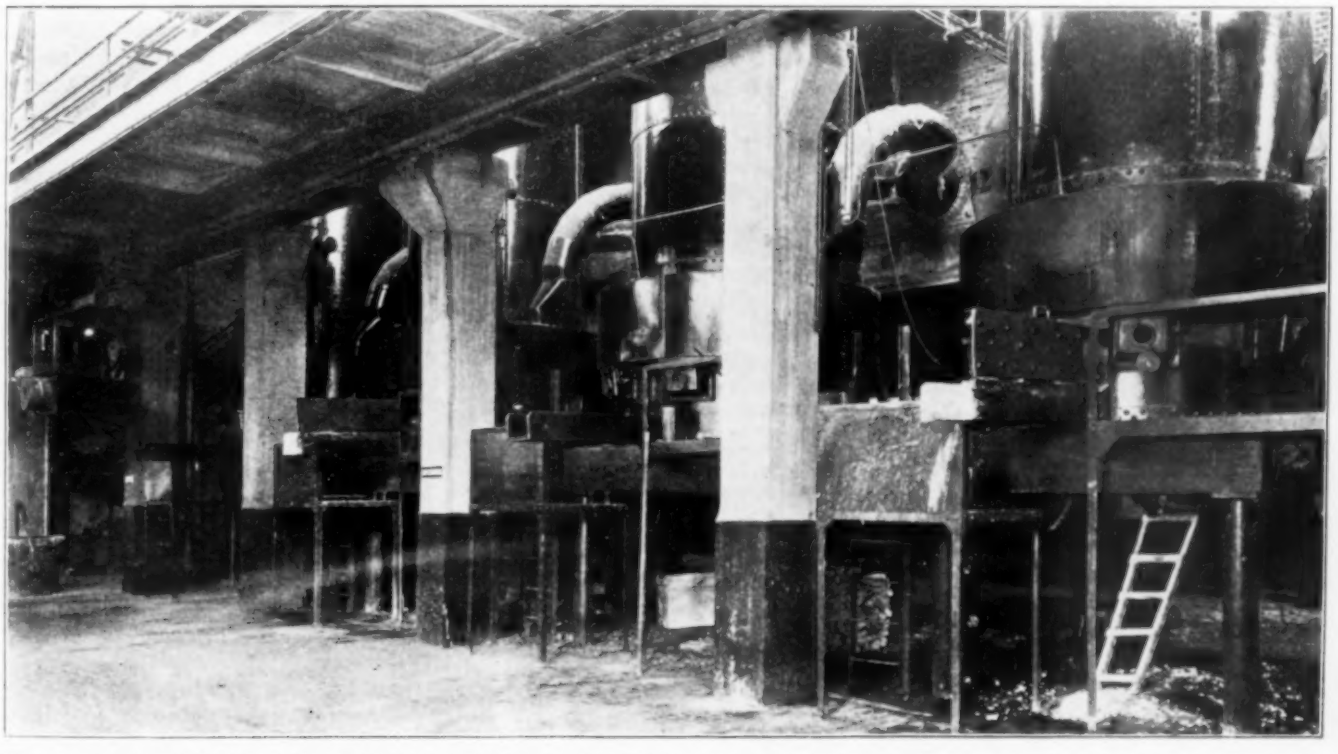


FIG. 10—A BATTERY OF FOUR CUPOLAS 90-INCH SHELL LINED TO 67 INCHES IS PROVIDED FOR MELTING THE IRON FOUNDATIONS. SPACE FOR TWO ADDITIONAL BLOWERS AND CHARGING FLOOR SPACE AND EQUIPMENT ARE AVAILABLE FOR OTHER TWO CUPOLAS WHEN CONDITIONS WARRANT THEIR INSTALLATION

which operates back and forth on the depressed track. The truck has a capacity for two charging cars and when loaded, it carries the charging cars to a point in front of either one of two electrically operated elevators which serve the charging floor.

With a view to supplementing the elevators and also as a precautionary measure in the event that either of the elevators should be incapacitated from any cause, the charging deck has been extended over the material bay to a point where the cranes in this department easily may deposit all the iron required to charge the cupolas.

The melting equipment includes four 90 inch cupolas lined to 69 inches each with a rated melting capacity of 18 tons per hour, tracks and transfer car, charging boxes and hoisting devices for dumping the charges both iron and coke into the cupolas through two doors on opposite sides. The general features of the charging floor and equipment are shown in Figs. 9, 10 and in the illustration at the head of this article. Two of the four cupolas are in use alternating from day to day. Provision has been made for two additional cupolas when conditions warrant their installation.

Three blowers each direct-driven by a 125 horsepower motor, are mounted on the mezzanine floor half way between the charging deck and the main floor. The three blowers discharge air into a common main pipe as shown in Fig. 9 and this main pipe feeds the individual pipes leading to each cupola. By a suitable valve arrangement, the air may be directed into any cupola or any combination of cupolas. Coke is forked by hand into the charging buggies which then are pushed onto the elevator and lifted to the charging floor.

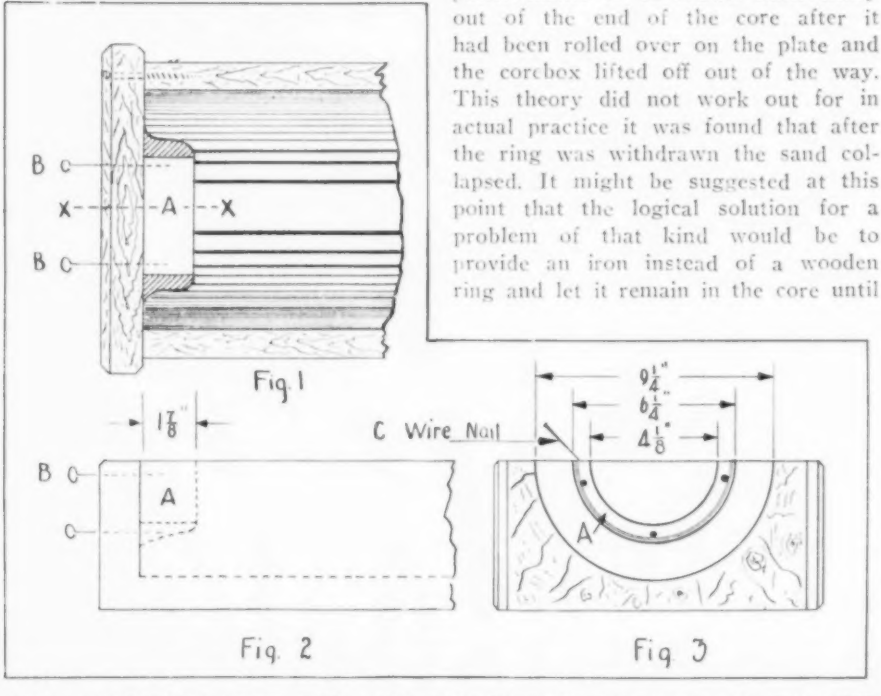
Transverse tracks extending at right angles from the battery of cupolas provide storage space for the charging cars. A transfer car, operating on a depressed track extending parallel to the cupolas, serves to convey the cars to a point in front of the charging doors in any one of the cupolas. After the contents have been dumped into the cupola, the empty car is returned to a point where it may be run onto the elevator which is provided with a pair of tracks capable of holding six cars. Parking spaces are provided in the material bay at a point opposite each elevator where a number of cars loaded or empty may be held pending the arrival of the elevator or the electric truck which hauls them back and forth to and from the iron supply.

Iron is removed from the cupolas in 4000-pound ladles suspended from a number of 5-ton trolley hoists operating on a monorail system with a total length of 5300 feet, almost a mile, and covering every molding bay in the foundry. The cupolas are located at a point midway from the ends of the building and at one side. Practice in connection with making the molds and cores and cleaning the castings will be described in an early issue of THE FOUNDRY.

Corebox Must Conform to Practice

OCCASIONALLY, when a pattern comes back from the foundry with a ring sawed in two or more parts or with a projecting permanent part dislodged and attached loosely by long wire nails, the patternmaker would do well to investigate the foundryman's reason for making the change, instead of assuming that it was an accident or that the foundryman had taken unwarrantable liberties with the pattern. A Pattern after all, is only a means to an end and should be constructed in such a manner that the foundryman may secure a maximum production with minimum trouble and expense. The corebox shown in the accompanying illustration is a case in point.

The half ring *A* held in place by the wires *BB* was designed by the patternmaker to be drawn horizontally out of the end of the core after it had been rolled over on the plate and the corebox lifted off out of the way. This theory did not work out for in actual practice it was found that after the ring was withdrawn the sand collapsed. It might be suggested at this point that the logical solution for a problem of that kind would be to provide an iron instead of a wooden ring and let it remain in the core until it was taken out of the oven. That idea is quite feasible and might be adopted under circumstances where the production warranted the expense incident to supplying an iron ring for every core made during the day. However, in this instance only one casting was required and probably the pattern and corebox never would be used again.



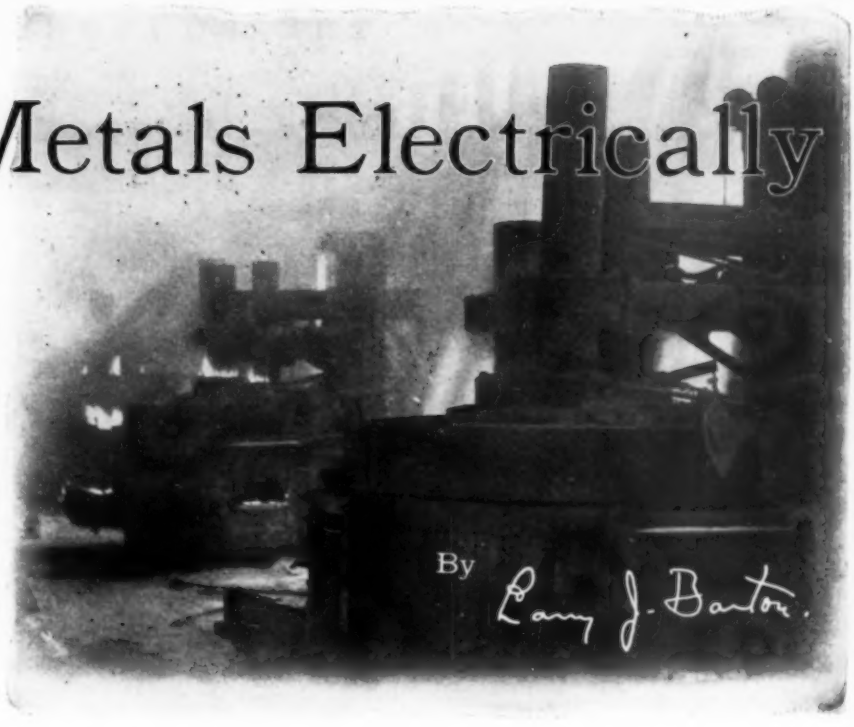
THE COREMAKER DREW THE RING BEFORE THE BOX WAS ROLLED OVER AND FILLED THE SPACE WITH DRY SHARP SAND

The coremaker solved the problem in his own way by breaking the ring *A* approximately in the center. After the sand was rammed in the box he drove the point of a sharp nail in the end of one piece as shown at *C* and pulled it out. He filled the space with dry sharp sand and then pulled the second piece out. This space also was filled with dry sharp sand. The corebox then was rolled over on the plate and removed from the core. The dry sand supported the upper body of sand in the end of the core until it had dried, after which it was brushed out.

Describes Machine

A booklet entitled "Fitting the Foundry for Better Business" recently has been published by the Beardsley & Piper Co., Chicago. The details of successfully applying the machine to the foundry are discussed. The publication is well illustrated with reproductions of photographs showing the machine in use in making various types of molds.

Refining Metals Electrically



Chapter III (Continued)

Chemistry of the Melting Period—Slagging Off Carbon Steel

THE initial charge, from a chemical standpoint, consists of an iron base together with certain amounts of iron oxide, manganese, silicon, carbon, phosphorus and sulphur. Of these, the iron oxide is the most important as it furnishes the necessary oxygen for the action of the first slag or the oxidizing period. Iron combines readily with oxygen from the atmosphere to form iron oxide, or rust as it is commonly known. This is in the form of Fe_2O_3 at normal temperatures. At temperatures of 800 to 900 degrees, the combination of iron with oxygen becomes rapid and scale is formed. This can be represented by Fe_3O_4 or $FeO.Fe_2O_3$. This always is formed when free iron is heated to this temperature in the presence of either air or steam, from the reaction

$$3\ Fe + 2\ O_2 = Fe_3O_4$$

But at temperatures over 1000 degrees with iron in contact with carbon dioxide another form of iron oxide may be formed, FeO.

$$Fe + CO_2 = FeO + CO$$

There are other possible ways for oxides of different kinds to be formed but from the standpoint of practical furnace operation, the above generalizations serve as excellent examples to show the reactions involved.

As all scrap metal contains an appreciable amount of rust, this is one large source of the oxygen needed. Then, in the melting down period, the furnace doors never are sealed completely, so air is drawn freely into the furnace from the outside atmosphere. This furnishes another source of oxygen. On the general run of low carbon steels, such as the present example, these amounts of oxygen are more than sufficient and may safely be considered as providing an excess of oxygen and requiring no ore to complete the reactions.

Phosphorus is oxidized easily when in the free state, by oxygen alone to form the pentoxide P_2O_5. In steel, phosphorus is combined as iron phosphide, Fe_3P, up to about 1.7 per cent P, having a melting point of approximately 910 degrees Cent. As the metal becomes heated to this temperature, the iron phosphide melts and combines with oxygen to form the pentoxide. From this point all iron oxide in the bath may be considered as FeO in making our calculations. This phosphorus pentoxide is an acid and must be neutralized as soon as formed, which under this process is naturally an automatic action in the presence of the heavy lime slag. The reaction by which the phosphorus is removed from the metal may be represented by

$$2\ Fe_3P + 8\ FeO = (FeO)_3.P_2O_5 + 11\ Fe.$$

This reaction will be in process before and during the oxidation of the silicon to silica, but the phosphorus will never be completely removed from the metal until all of the silicon has been eliminated. Silicon has the power of replacing the phosphorus pentoxide in the ferrous phosphate and exposing this oxide to further reactions. This power of silica accounts for the fact that phosphorus never is removed by any of the acid processes for making steel, because the formation of this compound is prevented by the high percentage of silica in the slags and the consequent retention of the silicon in the metal. In the basic process, the large excess of lime is sufficient to neutralize this silica so that not only is the ferrous phosphate allowed to form, but on reaching the slag is converted into a stable calcium phosphate:

$$(FeO)_3.P_2O_5 + 3\ CaO = (CaO)_3.P_2O_5 + 3\ FeO$$

However, this salt easily is reduced and the phosphorus only will be held by the slag as long as the temperature is highly oxidizing and in the presence of a heavy lime slag which is distinctly basic.

Silicon, under the influence and conditions of the electric furnace, forms but one oxide, that of silica, SiO_2. The tendency of silicon to combine with oxygen is even stronger than that of iron, due to the greater heat of formation of the oxides. This makes it capable of reducing any of the iron oxides and upon this fact is based the elimination of this metal from the molten steel.

Since at this temperature the most plausible oxide to suffer by this reaction is FeO, this elimination may be represented by

$$Si + 2\ FeO = SiO_2 + 2\ Fe.$$

Why Two Slags?

CHEMICAL reactions, each having for its purpose a definite part in eliminating harmful elements or adding those which improve the quality, in making plain carbon steel are explained by Mr. Barton in the accompanying article. Silicon and manganese are used as dioxidizers in the formation of the primary slag. When the carbon content of the metal is at the desired point, the manganese, silicon and phosphorus are as low as desired and the slag is of the proper consistency, the furnace is cleared of its first slag. Then a second of lime, coke and fluorspar is added if an average grade of steel is sought. For the better grades, requiring absolute deoxidation, with elimination of sulphur, a carbide slag is favored by the author. Further suggestions on sulphur elimination, some points on the use of fluorspar and the completion of the heat will be covered in forthcoming sections of the present chapter. These will appear in early issues.

Immediately the reaction is completed, the silica combines with the iron oxide to form a bi-silicate, tri-silicate or even some more complex salt of the two compounds, depending on the amount of the base present. This, from a practical standpoint, will occur most probably as

$$3\ Si+8\ FeO=(FeO)_2.(SiO_2)_3+6\ Fe$$

This ferrous silicate is in the fusion state, due to a lower melting point than that of the metal and being of lower density than the steel, rises to the surface and combines with the lime to form a slag. Here further changes may ensue. This silicate when first formed, was in the presence of a limited amount of base. With the ever present excess of lime, this silicate may change to the monosilicate from its previous state of a trisilicate:

$$(FeO)_2.(SiO_2)_3+4\ FeO=3(FeO)_2.SiO_2$$

The ferrous oxide thus combined becomes inactive, but is released to go back into the bath by the combination of this compound and the lime of the slag:

$$(FeO)_2.SiO_2+2\ CaO=(CaO)_2.SiO_2+2\ FeO.$$

This form of a calcium silicate is stable and safely holds all of the silica in combination under oxidizing, basic conditions. This calcium silicate forms the major part of the first slag in the electric process, but never is freed from the oxides of iron, due to its ability to hold them in solution.

Manganese with oxygen forms probably as large a number of oxides as any other metal, but under the conditions of the electric furnace only one exists, that of the true oxide MnO. Like silicon, the manganese alloyed in the metal as a carbide must be oxidized largely through the agency of iron oxide. However, as silicon is capable of reducing this oxide, it follows that manganese cannot be eliminated until the bath has been cleared of all silicon. Manganese may be considered as being eliminated coincident with the silicon following the equation

$$3\ FeO+Si+Mn=MnO.SiO_2+3\ Fe$$

When this silicate of manganese reaches the heavy lime slag, it follows the conditions of the previous ferrous silicate, under silicon. The manganese oxide combines with the lime and the silica is freed as has been shown, ultimately combining with the lime.

The manganese oxide will remain in the slag as a free oxide as long as the slag contains an abundance of iron oxides. If the supply of these were to become depleted, the manganese oxide becomes susceptible to reduction, the metallic manganese being reduced back into the steel. This will only happen under a reducing condition and will be further explained under the final slag period.

Carbon reacts differently from any of the elements previously explained. All of the combining reactions are exothermic and result in the formation of a solid compound combining with the lime to form a slag. The elimination of carbon causes an endothermic reaction, giving as a product the gas, carbon monoxide, CO. This rises up through the metal and into the slag where it is held in a loose or free condition. This gradually penetrates the slag blanket, causing a bubbling or what is known as the *boil*, which is often more or less violent. The gas issues from the furnace around the doors and electrode openings and burns with the oxygen from the air to form carbon dioxide.

$$FeO+C=Fe+CO$$
$$CO+O=CO_2$$

The operation of slagging off signifies an elimination of the oxidizing period and a change over to the period of reduction for the purpose of finishing the heat. Therefore, before the heat can be slagged there are certain conditions which must exist. They are:

The carbon content of the metal must be at the desired point.

Manganese, silicon and phosphorus must be as low as is desired.

The slag itself must be of the proper consistency and degree of oxidation.

At this point in operation, the charge is melted and the slag has formed, resting on the metal as a thick, viscous blanket. The metal still is cold and heavily impregnated with oxides, both in combination and held in solution. Due to this condition the slag is jet black in color. It is now good practice to put a bar in the furnace and clean the walls of any small pieces of adhering scrap. If there are any large bodies of scrap on the walls they are pried loose and shoved into the bath. The bar is now run over the bottom to make sure there are no *nigger heads* or bodies of unmelted metal resting there. If any, they must be pried loose, for if allowed to remain they will come up later when the temperature of the metal rises, projecting a large amount of oxides into the second slag and causing much difficulty in their reduction.

Table XXV

Analyses of Finished Basic Slags

	1	2	3	4	5	6	7	8
Silica	17.57	7.48	12.76	11.56	19.50	20.50	18.00	24.00
Iron oxide	1.33	0.35	0.46	0.31	1.00	0.71	0.40	0.52
Aluminua	3.12	2.17	....	....	....	....	....	....
Lime	62.45	65.82	67.48	68.10	60.30	61.91	61.11	55.53
Manganese oxide	0.36	0.05	0.25	0.29	0.60	0.61	0.32	0.40
Magnesia	11.65	13.78	....	....	....	....	....	....
Calcium sulphide	0.87	2.26	....	....	....	....	....	....
Calcium carbide	None	4.54	2.26	3.10	4.30	4.48	5.60	5.31
Sulphur	....	....	0.42	0.50	0.88	0.83	1.17	1.09

1 and 2. "Deoxidization and desulphurization in the Heroult furnace." F. T. Sisco "Chemical and Metallurgical Engineering" Jan. 4, 1922. No. 1 being for a white slag and No. 2 being for a white carbide slag.

Others from authors notes, the change in analysis depending upon the degree of desulphurization as evidenced by length of time the heats were held under this carbide slag. Nos. 3, 4, 5 and 6 were on steel casting heats, while 7 and 8 were taken from heats making forging steel for locomotive drive rods.

Preliminary Tests

As soon as all loose pieces of metal are melted and the surface of the bath is free from floating steel, it is time to begin final operations. The first of these will cover the percentage of carbon remaining in the metal. A test spoon is inserted through the door and a metal test taken, the spoon being rotated in the slag until a good covering is assured, as a preventative to metal sticking to the spoon. This molten metal is poured into a chill mold, made of two cast iron blocks, to give a test piece approximately 1 inch square and 6 inches long. This metal will be wild, sparking heavily while being poured and solidifying. There will usually be a heavy scull remaining in the spoon, signifying that the temperature of the metal is low. As soon as solid, this test piece is water quenched and broken.

There are many different ways of taking these test blocks and cooling them down preparatory to breaking. Some melters prefer to chill quickly in water, some allow to chill slowly in water by immersing and then withdrawing, while others allow the piece to cool in the air to a black. Any method gives the same results, but it must be remembered that all such tests must always be handled under exactly the same conditions.

This breaking is accomplished by placing the test bar on two rigid supports and striking with a heavy sledge hammer. Low carbon tests when so struck emit a dull thud and tend to bend before breaking. This is especially true for carbons under 0.15 per cent. Higher carbons will snap off easily on the first blow. From this degree of bend and from the appearance of the fracture, the amount of carbon present is determined. If desired, a sample can be sent to the chemist for a check analysis, but ordinarily on these

first tests the melter can judge so accurately that such a step is unnecessary. Low carbon tests will show a blowy appearance and the crystalline structure will have the appearance of having rather been torn apart than broken. The grain size of the metal will be large and the fracture will show fiery.

Lowering the Carbon

On heats of low carbon steel, this present percentage should not be over 0.15 per cent. If under this figure the heat may proceed, if not, the carbon must be lowered. On all such heats, melting in the basic furnace when the initial charge contains approximately 0.20 to 0.30 per cent carbon with standard amounts of manganese and silicon, the rust in the scrap will be sufficient to cut the molten metal down to such low figures as carbon, 0.05 to 0.15 per cent; manganese, 0.05 to 0.20 per cent and silicon, 0.02 to 0.06 per cent, in the great majority of cases. Under such conditions, the percentage of carbon is a good indication of the amount of the other alloys present. If the carbon is low, it is safe to assume that the other elements also are low, for the reason that they tend to oxidize out of the metal before the carbon begins to drop.

If a high carbon test is shown, the manganese and often the silicon will also be up and it will be necessary to add ore or some other form of oxide to boil out these elements. Ore should be added in amounts of about 25 pounds at a time, each addition being allowed to work before a further amount is added. These small lots will soon cause an evolution of gases as the elements are oxidized which give rise to the familiar *boil*. This bubbling should be allowed to proceed slowly, but constantly until the carbon, on test, is low enough. On a 6-ton furnace, it will take approximately 15 minutes to lower the carbon 0.05 per cent, depending on the amount of manganese present, as this must be oxidized before the carbon will be attacked.

Many shops use other materials than ore such as mill scale, cinder, or crushed ore, for producing this oxidizing condition. The writer prefers ore in lumps about 2 to 4 inches in diameter on account of its penetration of the slag immediately after being thrown into the bath. The other materials tend to float on the slag and work on the metal only in an indirect manner. However, this is merely a matter of opinion.

Conditioning the Slag

The chemical composition of the metal being correct, the slag is brought to its proper condition. This first slag should be dull black in color, and strongly basic. It should be rather tough on fracture, and should have the appearance of a piece of lava. If too thin, more lime should be added to thicken it; if too thick and lumpy it can be thinned by the judicious use of a small amount of crushed fluorspar. A thin, glassy slag shows the presence of too much silica and may be even tending toward an acid slag. Such a thin slag will have no effect on the phosphorus, allowing this element to pass back into the metal. Slags in the presence of a high percentage of carbon and manganese will show a dark brown color, this being an indication of reducing conditions. Such a slag must be converted into the black, lava like slag before it can act as a remover of phosphorus.

Satisfactory first slags usually will follow close to the following analysis: Silica, 10 to 15 per cent; manganese oxide, 7 to 10 per cent; iron oxide, 10 to 15 per cent; lime, 45 to 60 per cent; magnesia, 4 to 8 per cent and phosphorus pentoxide, 2 to 4 per cent.

Both burned lime and limestone are finding wide use for building electric furnace slags, especially on the first slag. Burned lime has an advantage as less of this material is required per ton of steel, but this is obtainable at a slightly higher cost for the initial product. Limestone is much cheaper and while calcining tends to cause an auxiliary boil in the furnace. This tends slightly to counteract the power necessary for calcining. Either may be used during the oxidizing period with equal success, when working on the general classes of soft or medium steel castings. Limestone never should be used in reducing slags or in high quality heats, due to the fact that one of the products of its calcination is the gas, carbon dioxide with one free atom of oxygen at high temperatures in the presence of carbon, this oxygen when freed requiring increased reduction to eliminate.

Finishing the Heat

The furnace having been cleared of the first slag, it is tipped back into normal operating position and ferromanganese added. The amount thus added is calculated either from results of previous heats of the same scrap character or from the result of the chemist's analysis of the preliminary test. Under general operating conditions, the residual manganese in heats of this kind may be closely estimated at from 0.05 to 0.10 per cent with a high degree of accuracy. The manganese may be added as calculated to the point desired, no loss being figured in this reducing operation. I have made thousands of heats of this soft carbon steel calling for manganese 0.30 to 0.40 per cent, the manganese addition being calculated at 0.30 per cent based on the weight of the charge, with few of analyses, although no chemical analysis was made on the preliminary test. This alloy should be broken into pieces the size of one's fist and after being added, given a few minutes thoroughly to diffuse throughout the metal.

The second or deoxidizing slag may now be made and added to the furnace. This slag will consist of from 2 to 6 per cent of the charge's weight in lime; about 20 to 30 per cent of the lime, crushed fluorspar and 4 or 5 large scoops of finely ground coke. The exact composition of this slag will depend upon the amount of sulphur to be eliminated from the metal.

Describes Finishing Slags

The two classes of finishing slags are the ordinary white lime slag and the white carbide slag.

The white lime slag makes a compound pure white in color which on exposure to the air, disintegrates to a fine white powder. Generally, it is made of lime, coke and spar in the ratio of about 8 to 10 of lime, to 1 of coke and 1 of spar, making a slag with about 25 per cent acids to about 75 per cent bases. Such a slag is not strongly reducing, but tends to act more as a protective blanket for the metal than anything else. Lime is thrown upon the bath until there is a fair covering, when the slag is given a heavy dusting of coke and allowed to heat. If the slag appears heavy, additions of sand or spar may be made, spar being preferable, due to the fact that it furnishes a better thinning effect, together with its basic composition eliminating any tendency to dilute the basic effect of the lime slag.

Deoxidation with such a slag is not rapid and never can be accomplished finally without the use of ferrosilicon. The oxides in the bath, under such a slag, gradually will rise to the surface as the temperature of the metal increases. Here they will combine with the slag, the oxygen being eliminated by the crushed coke. Deoxidation by this method will proceed slowly and even after several hours under this slag, the metal will still show wild. The method of operation is to bring the slag into such a condition that it powders on exposure to the air, when small amounts of ferrosilicon are added until a solid test is obtained when the final additions can be made and the heat poured.

While the degasifying effect of such a slag is not of the highest quality, there is one great advantage. There is no appreciable carbon absorption from this slag into the metal. While this is important when working on heats of a low carbon content, it is not sufficient

to overcome the many disadvantages, for deoxidation is too slow and is never certain. To really deoxidize the metal, it is necessary to make constant additions of ferrosilicon. Such additions have as a product the non-metal silica which often may remain in the metal as inclusions. There is no certainty that oxides in solution or combination with the metal will be removed in such a manner.

Consequently, the use of such a slag is limited to the poorer grades of steel in which the carbon content must be kept low. In such a case, the amount of lime necessary only will have to be enough thoroughly to cover the bath, 2 per cent of the charge being plenty.

Carbide slag is used in cases where absolute deoxidation is required, and where sulphur is to be eliminated. It consists of from 4 to 7 per cent of the charge lime, depending upon the sulphur content desired in the finished metal; about 30 per cent of the lime, spar and about 50 pounds of coke dust.

This slag upon exposure to the air disintegrates into a gray powder, giving off a strong odor of acetylene when coming in contact wtih water. Such a slag has strong powers in eliminating any gases present. A heat of steel made under this class of slag gradually will settle itself down, requiring a minimum of alloys to produce sound castings.

Whatever type of slag is to be used, it should be made up on the furnace platform and all lumps broken and thoroughly mixed before being added to the furnace. If the carbon content of the steel is extremely low and there is a considerable leeway between the present figure and that desired, it is excellent practice first to dust the entire surface of the steel with ground coke, and quickly add about half of this second slag. Another coke dusting then may be made on the surface of the slag and the doors tightly sealed.

During the period of slagging off, the bath has become covered with a scum of oxide, from the air. As soon as this second slag is added to the furnace, it combines with this oxide and changes color from a pure white to a dead black. As the temperature rises and deoxidation proceeds, this oxide gradually is eliminated, the color turning to a dark brown, a light brown, a gray and finally to a steel gray, powdering in the air. This slag will tend to foam in the furnace, especially around the electrodes. The remainder of the slag mixture now is added and the furnace allowed to run until a slag of the proper consistency is obtained. This slag will transmit the greater part of the heat to the metal below, radiation to roof and walls being kept to a minimum. It will not attack the banks and will rapidly eliminate gases and sulphur.

At the start of reduction, immediately after slagging off, the metal is in a highly oxidized state, analyzing approximately 0.08 per cent carbon, 0.01 silicon and 0.08 manganese. The ferromanganese added raises this figure to about 0.35 or 0.49, the manganese immediately starting its deoxidation by combining with the iron oxide: $Mn+FeO=MnO+Fe$. This manganese oxide, being lighter than the metal, rises to the surface, combining with the slag. This slag, due to its heavy covering of coke, is highly reducing and the manganese oxide is immediately acted upon:

$$MnO+C=Mn+CO$$

The carbon monoxide burns at the roof ports to the dioxide and the manganese goes back into the bath. This circle of reactions is kept up until the bath is thoroughly freed of all oxides, when the manganese remains in the steel as an alloy. This reaction to take place with favorable results requires a minimum of about 0.30 to 0.35 per cent manganese present in the metal.

The slag, when first thrown into the furnace, picks up a heavy charge of iron oxide from the metal itself. This is acted upon by the coke, coincident with the preceding reaction and results in forcing iron back into the metal:

$$FeO+C=Fe+CO$$

Therefore, the combined result of these two reactions is to free both the steel and the slag from their charge of oxides, resulting in sound metal and a powdering slag.

As soon as this condition is reached, the free lime in the slag begins to combine with the coke to form calcium carbide. This first occurs directly under the arc, but gradually proceeds over the entire slag, resulting in the familiar smell of acetylene when such a slag is quenched in water. $CaO+3\,C=CaC_2+CO$. It is at this point that absolute deoxidation and desulphurization begins. Whether manganese or iron sulphide plays the most important role in this, is difficult to decide, but that the gases and sulphur are removed cannot be doubted. The sulphur is removed by being changed into the insoluble calcium sulphide. The reactions of this elimination follow:

$$\frac{FeS}{MnS}+CaO+C=\frac{Fe}{Mn}+CaS+CO$$

$$\frac{3\,FeS}{3\,MnS}+2\,CaO=CaC_2+\frac{3\,Fe}{3\,Mn}+3\,CaS+2\,CO$$

$$CaS+\frac{FeO}{MnO}=\frac{FeS}{MnS}+CaO$$

This presence of calcium carbide, with its attendant acetylene, thus is shown to be a sure indication that the bath is deoxidized, but under no condition should a heat be poured on this proof without taking a final metal test. On a low carbon steel, it often is impossible to keep a heavy covering of coke, due to the carbon being accessible to combination in the metal. In a case of this kind, when working under a rigid specification, sulphur may be removed by the use of silicon. This is another reason why about 0.05 to 0.10 per cent silicon always is added in the working of low carbon steels before a solid test is obtained. The reactions follow:

$$\frac{2\,FeS}{2\,MnS}+2\,CaO+Si=\frac{2\,Fe}{2\,Mn}+2\,CaS+SiO_2$$

$$\frac{2\,FeS}{2\,MnS}+2\,CaF_2+Si=\frac{2\,Fe}{2\,Mn}+2\,CaS+SiF_4$$

This last reaction is made possible by the addition of fluorspar to the slag, the silicon fluoride being given off as a volatile matter. The amount of silicon necessary for these reactions is close to the theoretical amount, but a slight excess always should be provided as these reactions will only take place after the absolute deoxidation of the bath. Table XXV shows analyses of finished basic slags.

Detroit Foundrymen Meet

The opening meeting of the Detroit Foundrymen's association was held at the clubhouse of the Detroit Engineering society Sept. 18. A dinner was served at 6 p.m. preceding the meeting at 8 p.m. Dr. Richard Moldenke, Watchung, N. J. spoke on "Coke and Its Allied Topics." He also described some of his experiences in Europe. A committee was appointed to co-operate with the Detroit convention bureau to secure the 1925 convention of the American Foundrymen's association for Detroit.

Of the 87 establishments engaged in the manufacture of aluminum products in 1921, 22 are located in Ohio; 15 in New York; 12 in Wisconsin; 6 each in Illinois and Pennsylvania; 5 in New Jersey; 4 each in California, Massachusetts and Michigan; 3 in Missouri; 2 each in Connecticut and Rhode Island; 1 each in Nebraska and Tennessee. Wisconsin, the leading state in the industry in 1921 produced 25.1 per cent of the total by value of the products in that year.

How and Why in Brass Founding

By Charles Vickers

Suitable Brass Mixture for Jobbing Work

We desire to know the proper pouring temperature for ounce metal, also the amount of a 15 per cent phosphor copper to use in the above alloy, what is the result on the castings if too much phosphor copper is used. Another matter about which we would be informed is what is the most fool-proof mixture of brass suitable for jobbing work.

There is no proper pouring temperature for ounce metal, what would be the correct temperature for one casting might be too hot or too cool for pouring another casting depending on its size. One large concern brings the alloy up to 2250 degrees Fahr., in the furnace, then pours into ladles which are handled with celerity to pour off a floor of small castings. The first molds are always poured hotter than the last molds, which is unavoidable. Not more than 2 ounces of 15 per cent phosphor copper should be used to 100 pounds of any red brass alloy, about one ounce is usually sufficient, because of the small amount of phosphor copper required for such alloys. It is advisable to use the red brass deoxidizing alloys that are now being sold. An excessive amount of phosphorus used in a mix makes rough castings that will leak under slight pressures as in the case of red brass it renders the mixture un-homogeneous.

There is no fool proof mixture for red brass. The different mixtures have to be melted with care to guard against absorbtion of gas by means of covering the surface of the metal with charcoal in crucible melting. In a general way, a mixture containing a large percentage of zinc will run sounder than one containing a small amount of zinc. A good, inexpensive alloy is the following: Copper 82 per cent; zinc 11 per cent; lead 5 per cent, and tin 2 per cent.

Describes Nickel Babbitt

We have a number of special bearings to make which the customer specifies are to be babbitted with nickel babbitt. We are wondering if you could give us any information with regard to nickel babbitt? We have applied to several manufacturers of babbitts for price and analysis, but so far have been unable to get the analysis.

It is scarcely to be expected that manufacturers of special alloys such as nickel babbitt would be willing to present anyone with full particulars as to its composition, as the makers are interested only in selling their product. So called nickel babbitts do not always contain nickel. The addition of nickel does not improve the qualities of the babbitt sufficiently to justify its use over copper as a hardening element. The following is an analysis of a nickel babbitt that contains nickel: Tin, 85 per cent; antimony, 9 per cent; copper, 5½ per cent; nickel, ½ per cent.

Bronze, Brass Alloys To Withstand Weather

We are going to cast a cross in brass to be used on the top of a church. What mixture of brass do you think would be best to use to withstand all kinds of weather conditions?

Alloys of either bronze or brass withstand the effects of the weather for centuries. As far as this requirement is concerned either yellow brass or a bronze or a composition may be used. The point to consider is the casting qualities of the alloy. Yellow brass is the more difficult metal to make into castings and probably the casting would have to be made over a couple times before an acceptable one would be obtained. However if yellow brass is preferred the following alloy is suggested:

YELLOW BRASS

	Per cent
Copper	70
Zinc	25
Tin	3
Lead	2

A good, easy running red metal is the following:

RED METAL

	Per cent
Copper	88.50
Tin	5.50
Zinc	3.50
Lead	3.50

The latter alloy is the best casting mixture. If the cross is to show the color of bronze permanently, it will be necessary to finish it, polishing the high lights and then to coat it with a lacquer of the best grade obtainable. This will have to be renewed from time to time, or the brass will tarnish under the influence of the weather. It will acquire what is known as a patina. Examples of this coloring may be seen by noting statuary or castings of a similar character in any city.

Use Heavy Nickel Plated Copper Scrap

Can you inform us if any trouble would be caused by using scrap copper which is heavily nickel plated? We have used considerable of this material in making mixtures for pressure goods and at times experience difficulty with porosity at the gate, on such castings. We are wondering if the slight amount of nickel could be responsible.

The small amount of nickel carried into an alloy by plated copper would be difficult to detect by any effect it might produce. If it had any effect at all it would incline to be beneficial than otherwise. Nickel is intentionally added to alloys in order to densify that they may resist pressure, and there seems to be some evidence that it does have some such effect. The use of nickel as an addition to bronze and red brass is becoming prevalent.

The porosity must be due to some other reason, but we are unable to state the cause. The word porosity is not always used in the same sense. In this case it reads as though the gates only were porous, and this may simply be a shrink or it may be the runners are not high enough in the cope and fail to feed properly, in which case there would be a certain percentage of the castings defective more particularly those poured at the end of the line. If the castings are porous, the condition will show on any surface of the castings that may be machined, and will not be confined to the gates, or parts adjacent thereto.

Physical Properties of McAdamite Metal

We would like to obtain the formula for Macadamite metal.

An alloy frequently used under the name of McAdamite has the following composition:

COMPOSITION OF MCADAMITE

	Per cent
Copper	70
Alloy of 50 per cent copper, 50 per cent aluminum	7
Zinc	23

Test bars of the above alloy have given the following physical properties: Ultimate strength, 33,900 to 35,600 pounds per square inch; yield point, 20,600 to 21,000 pounds per square inch; elongation, about 1 per cent in 2 inches.

Bill Discusses Cost Keeping Methods

BY PAT DWYER

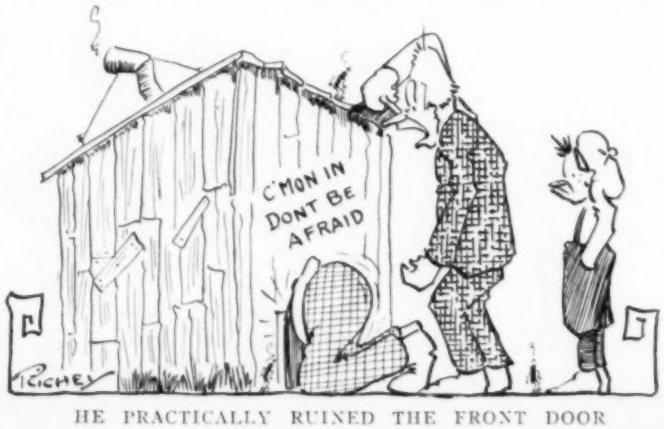
BELIEVING firmly as I do in the proper and equitable division of parental authority I have left that part involving jurisdiction over the childrens' clothes to their mother. I furnish the means for purchasing the garments. I like to see my relations becomingly attired, I have my own private views on the subjects of color, cut and material and in the event that I should be consulted I stand ready to express these views loudly and distinctly, but since I never have been consulted to date, naturally these views—excellent as they may be in themselves—are negligible factors in our household operation. I am not a nosey person, if you take my meaning and I have no desire to set up as an arbiter of fashion, especially for young people. The most laudable ambition has its limitations. Occasionally, a condition arises which I cannot consistently ignore and as a result I find myself dragged into a position where I am supposed to render a decision that is bound to be unpopular with at least one of the interested parties. I suppose I should be satisfied with a 50-50 break, but it never works out in that way. In some mysterious manner I always retire from a contest of this character with the impression that I am the guilty party

At various times during the summer holidays I had noted signs of the most extraordinary activity in our back yard where a gang of young hopefulls, including my youngest hero, aged 9, were engaged in building a shanty. For some inscrutable reason, inscrutable at least to my dulled mature understanding, each member found it necessary to dress in a costume that was a cross between that of a movie cowboy and a buccaneer. Each of these ferocious young gentlemen adventurers had a gaudy handkerchief tied around his head. A section of clothes line, more or less neatly coiled was suspended from a belt which fairly sagged from the accumulated weight of many weapons including a mighty two-handed sword, several murderous looking knives and at least two long pistols all carved from pieces of lath. The pistols were painted black, while to convey the proper sanguinary effect, the point of the sword and the greater part of each knife blade had been smeared plentifully with scarlet paint. The entire assembly was worthy of the bloodiest pirate in earrings and jack boots that ever sailed the Spanish Main or waded ankle deep in the hot red blood that washed the decks under the folds of the Jolly Roger.

From scraps of high pitched and excited conversation that floated in through the open window on various occasions, I might have been justified in assuming that a major battle was in progress. However, on paying close attention I gathered that the services of neither a surgeon nor an ambulance would be required. The young marauders merely were engaged in building a hut on a lonely, south-sea island as a kind of a central rendevous and treasure chamber. The councils of war were to be held in this quiet retreat and the gold bars and pieces of eight were to be stacked under the bunks. No provision was to be made for the reception of prisoners and no revenue was to be derived through the expedient of holding prisoners for ransom. The victims of their piratical raids were all foredoomed to walk the plank in accordance with the universal tradition that dead men tell no tales. Yo! Ho, Ho, and a bottle of rum!

On several occasions the lady who is related to me through marriage, and therefore jointly responsible in converting the primeval young savage into a useful member of society, was moved to remonstrate with me on my apparent lack of interest in his evolution. She claimed, heaven knows why, that he was being ruined, his mind was being warped and unless I took drastic measures—particulars omitted—he either was bound to run away to sea or become involved in a life that led straight to the electric chair. I could not see it in that light. Basing my opinion on my own experience at a somewhat similar age, I mildly suggested that in all probability he either would enter the church or blossom out as a white aproned attendant behind the cheese counter in a neighborhood grocery store.

However, as I said before, came a day—to quote freely from those masters of English prose who write our movie captions—came a day when a young lad was dragged in for my horrified inspection. I feel I am violating no confidence when I state that a proper horrified expression is assumed by clinching the hands and dilating the eyes to the fullest extent. The expression of any other emotion easily is attained by the same simple expedient. Occasionally a more subtle touch is achieved by pretending to slightly gnaw the back of the knuckles on one hand.



HE PRACTICALLY RUINED THE FRONT DOOR

Choice of hands is immaterial. Southpaws invariably use the left. This merely is an inconsequential detail and in deference to the well known temperamental idiocyncrasies of our peerless artists, is left entirely to their personal discretion.

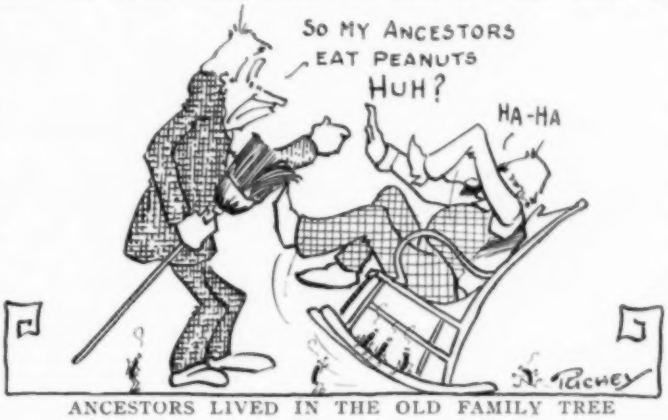
In this particular instance, my horrified gaze rested on a pair of pants with both knees completely worn out and with ragged streamers flowing from the sides. His mother, that is, the boy's mother, held him firmly by one ear and begged me earnestly to gaze on the remains of a garment for which she had exchanged three perfectly good and negotiable dollars two days previously. The gallant warrior squirmed to such an extent that I was fully convinced unless he speedily mended his ways his ear was in imminent danger of being pulled hopelessly out of plumb.

I directed his mother's attention to this trifling detail, but was told tartly that she had not brought him in to discuss his ears. Going deeper into the subject, she intimated that if the child developed long flexible ears he came by them honestly, but he did not inherit them from her side of the house.

From a fairly extensive and intimate knowledge of boys and their ways—I was one at one time—I felt reasonably certain that the ragged knees were not caused by excessive indulgence in devotional exercises. I also knew they might be due to any one or a combination of many causes. By a process of logical elimination I might have arrived eventually at the answer to the puzzle, but that entailed a long and tedious process. I determined to try the direct method. With a view of conserving time, trouble and patience I asked the temporary owner of the pants to account for his disreputable appearance with particular reference to the torn breeches. I was going to show his mother a trick or two on how to bring up children.

He told me quite cheerfully he had no idea how he had worn them out. Apparently here was a poser. The examination promised to present complications worthy of deep thought and, as you might say, constructive criticism. If the victim does not know how an accident happened, what chance has a mere outsider to arrive at either an explanation or a decision?

Casting back through the years I tried to imagine what my one time hero Nick Carter would have done in a case of this kind. Without disparaging his phenomenal ability in the least, I really felt that here was a case worthy of his talents. Probably if he had been present he would have quaintly referred to it as so much duck soup, but unfortunately I had no spoon. Early impressions are lasting and invaluable. I decided instantly that his first step would be to visit the scene of the mystery and give it the once over. In other words and employing the proper technical terms he would subject the scene to the double-O.



ANCESTORS LIVED IN THE OLD FAMILY TREE

Quite naturally I realized my limitations in that I had no pocket microscope, tape measure graduated to read either in fractional parts of an inch or in millimeters, plaster of Paris for taking casts of possible foot prints, or the necessary apparatus for examining any stray drops of blood to determine whether they were of human origin or merely represented the nocturnal activities of a pair of love sick tom cats. Unimportant details, perhaps, but your thorough investigator overlooks nothing however trifling. For confirmation see *Nick Carter Among the Hicks, or Who Stuck the Knife in the Turnip* and other chronicles of episodes in the life of the indomitable sleuth who put New York on the map at a time when Mr. Burns was wiping his nose on his sleeve and going around with one stocking hanging down and the other held precariously in place with half a shoe lace. Grasping the young desperado firmly by one of his grimy little paws I was proceeding toward what is known among the elect as the *tradesmen's entrance* when Bill opportunely rambled in by way of the front door. I begged him to excuse me for a few moments while I pursued a little private investigation. He assured me investigation was his middle name and kindly offered to accompany me. Further, he generously volunteered to place his time and whatever measure of talent he possessed entirely at my disposal. I saw no reason for refusing his well meant offer. In fact I intimated that we might find it necessary to work in relays before the mystery finally yielded up its secret. The lady made no move to indicate she was coming with us. She characterized the entire proceeding as so much nonsense and wilful waste of time that might be devoted to better purpose. Any person with half an eye—yes, even a crooked eye—could see why the pants were torn. What she wanted to see adopted was some suitable measure that would prevent a second catastrophe. We left her talking and ducked out into the great open spaces in the back yard.

The embryo Captain Flint showed us his 4 x 4 pirate stronghold and with justifiable pride pointed to its many excellent features including a door about 11 inches square near the corner and at the ground level at one end. For purpose of demonstration and also probably in some measure to relieve the embarrassment he felt in attracting so much attention, he promptly dropped to his hands and knees and scuttled through the opening like a rabbit diving into a burrow. Bill solemnly winked at me and I gravely returned the salute. The bally old mystery was solved.

LITTLE JOHNNY HUNNYGUNKLE THE FIRST TIME UP THROWS A HIGH FAST ONE OVER THE PLATE

"What that lad needs" said Bill, "Is a pair of pants made from a fairly light piece of armor plate."

The young pirate on the inside invited us to enter and view the interior, but we unanimously and reluctantly declined the pleasure. "The faith of children" said Bill, solemnly "is touching."

"'Touching', is right", I said. "They always have their little fists stretched out for something."

"Tut, tut," said Bill, "I had reference to the implicit faith of any person who believed in your ability to squeeze through an opening no bigger than an ordinary knot hole in the side of a wall. He must have been reading the story of the camel who was supposed to ooze through the eye of a needle or something like that. If you ever intend to enter that shanty you first will have to get some husky bird to give you half a dozen passes through the roughing rolls in a blooming mill. That is one form of reducing exercise that always produces results. Steam hammers and hydraulic presses have their fine points, but in your case I earnestly should recommend the rolling mill." Bill has such a quaint sense of humor. I think his male ancestors must have held fully paid up cards in Local No. 1, International Gladiator's union. I even suggested the idea to him after we had tip-toed around from the back yard without going through the formality of rendering a decision on the great knickerbocker mystery and had planted ourselves in a pair of comfortable chairs on the front veranda. The season is getting late but the temperature still is pleasant in the afternoon while the sun is shining alike on the just and the unjust.

"Well," said Bill, "I'll tell you. I am not worrying myself sick or losing any sleep over the identity, if any, of my ancestors. They may have been gladiators, they may have been in the gallery eating peanuts and hurling pop bottles into the arena, or they may have been Roman foundrymen casting bronze statuary and trying to meet the cut-throat competition of outside firms in Athens, Florence and Naples. Unfortunately, no records are available on this phase of the casting industry in ancient times, but I am willing to bet you any reasonable amount up to $1.50 at any odds you care to name that these old foundrymen had the same problems to face as those which confront foundrymen of the present day and generation.

"They quoted a flat price per pound and then went forward cheerfully in the blissful faith of the fruit peddler that what they lost on *de peanutta* they would make up on *de banan'*. In some cases their faith was justified while in others they were left to gather whatever satisfaction they might from the melancholy privilege of being allowed to hold the bag.

"In recent years, thanks to movements sponsored by various foundrymen's associations in this and other countries, foundrymen are beginning to devote some attention to the subject of costs and cost accounting. Carefully prepared papers are presented from time to time through the columns of the technical press.

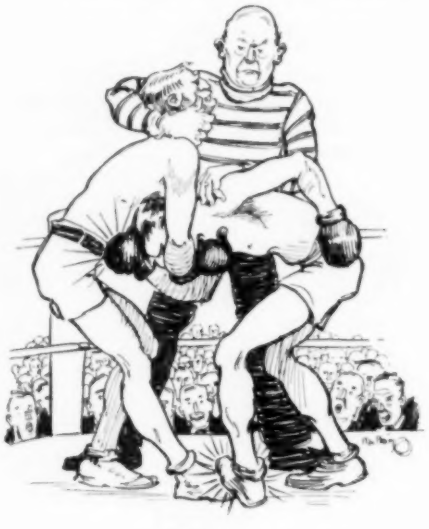
"The great trouble with the average foundryman is that he does not apply his cost system in a proper manner. He seems to think that if he installs a more or less complicated system of forms and cards and records, his troubles automatically will take wings to themselves and fly away. When the wings fail to sprout, he joins the army of unbelievers and tells you confidently that these cost keeping systems are all bunk.

"The primary purpose of any cost system is to direct attention to the cost of the various items entering into the operation of the business. The foundryman is no further ahead at the end of the year if he merely learns that each item costs so much than he was before when he merely knew his total expense. Only by comparing his costs item by item with the costs of similar items in competing firms is he in a position to apply the knowledge intelligently. For example, if he learns that a competitor can market a line of castings at a profit for a certain figure, he has an incentive to devise a method to meet that competition favorably.

"The broad general principles of cost keeping are fairly simple and once installed to suit the scope of the business the method may be perpetuated by any bookkeeper. The application of any system so that it will produce results is a problem of a different character and requires a broad knowledge of foundry operation on the part of the manager. The various forms, charts, reports, merely are the tools and materials by and with which the executive can build an enduring money making machine. In its last analysis that is all a foundry is, a money making machine. Quite true, many do not make any money, but you must remember that no machine is entirely automatic. The best of them require intelligent attention. "Speaking about bookkeeping methods" said Bill, as he arose to depart, "reminds me of the young lad who went into a drug store and asked the proprietor for 5 cents worth of asafetida. He further requested the druggist to wrap it in a parcel for him and finally after he had accepted the parcel he languidly told the man of pills to charge it. "What name," said the druggist, peering suspiciously over his glasses. "Hunnygunkle," said the kid. "Take the stuff and keep it," said the druggist wearily as he closed his book and replaced his pencil behind his ear. "I ain't goin' to write no two such words as Hunnygunkle and asafetida for no 5 cents. Beat it out of here.

"These here druggists," said Bill, "can talk as rough as any other class of people when they are properly primed."

Faked Foundry Facts



Parting

Discuss Refractories

About 100 attended the first meeting of the year of the Quad-City Foundrymen's association which was held at Moline, Sept. 22. D. A. Williston, Laclede Christy Clay Products Co., St. Louis told of the use and abuse of refractories. He pointed out that less progress has been made in the study of refractories for the cupola and their application or use in the cupola by foundrymen. than in any other metallurgical industry. A film entitled "The Story of Fire Clay Refractories" was shown.

H. W. Brown, secretary, the Tabor Mfg. Co., Philadelphia, has been spending several weeks on the Pacific coast making a survey of conditions and arranging for direct representation.

Investigate Electric Gray Iron

American Electrochemical Society Assembles Round Table on Electric Furnace Practice Applied to Cast Iron—Growth of Electrical Methods of Heat Treating Described

ELECTRIC furnace gray iron focused attention of chemists, metallurgists, foundrymen and manufacturers at the 46th meeting of the American Electrochemical Society held in Detroit, Oct. 2, 3, and 4. A special round table discussion arranged and held under the chairmanship of George K. Elliott, Lunkenheimer Co., Cincinnati, drew an attendance of over 150 including representatives from the large foundry and automobile manufacturing interests of Detroit.

In introducing the subject, Dr. Richard Moldenke, Watchung, N. J. dwelt upon the attributes which recommended the electric furnace for use in melting gray iron. He defined cast iron as steel plus carbon, and stated that the electric furnace may be used to supply super-heat, to deoxidize and desulphurize the metal. The limitations to general adoption of the Electric furnace method of melting include the high initial cost of installation, the lower comparative tonnages which it is possible to melt and the high cost of current in comparison with coke, in most localities. He commended electric gray iron for certain purposes and dwelt upon the merits of preheating the charge as is practiced in the duplexing process, where iron first is melted in the cupola and then refined in the electric unit or is brought to a red heat and then charged into the furnace.

The subject of melting gray iron borings was introduced, and many who had tried the electric furnace for this purpose spoke of the slow melting induced by entrapped air in the borings acting as a muffle, and the difficulty of melting the bottom of the charge when a direct arc type unit is used. The mixture of borings with sprue and scrap was advised when attempting to use them in the electric furnace, although it was stated that the induction type furnace successfully handled borings alone. In the latter instance the difficulty encountered was the necessity for a molten bath to start the furnace. Further, the reduction of sulphur is not so pronounced with the induction type furnace as with the direct arc types. The inabilty to obtain borings which are not too badly oxidized and the prevalence of brass or copper among iron borings are sources of danger in melting this material to make quality gray iron castings. Briqueting, with or without the admixture of 10 to 20 per cent coke was recommended for borings to be cupola melted.

A Pacific cost foundryman reported that with pig iron at $30 a ton, coke at $15 a ton, and hydroelectric power at 1 cent per kilowatt hour, he can produce gray-iron castings from the electric furnace at practically three-fourths the cost of cupola metal. In this case the metal was used for jobbing castings, but the plant is primarily a steel foundry making about four heats a day, two each of steel and iron. The steel following immediately after the gray iron charge is notably high in carbon. A product which is made largely from electric furnace gray iron is iron balls for concentrator mills. These are produced in quantities ranging from 10 to 20 tons per day, and an exceptional quality of fine grain, tough, white iron is obtained low in sulphur, phosphorus and silicon.

A southern producer spoke of making a good quality gray iron from steel scrap, recarburized in the basic furnace before silicon is added. The basic furnace is used because it is impossible to get rid of the sulphides in the acid lined unit.

In explaining the chemistry of electric furnace reactions on gray iron, Mr. Elliott pointed out that in the basic furnace the slag is in a reducing condition and will lower the sulphur, while in the acid type, the sulphur is affected only in a minor way. Phosphorus of cast iron is not affected in either the basic or acid furnace. Silicon is lowered in the basic, but is picked up from the slag in the acid. Manganese is lowered in the acid and not affected in basic. Carbon is but little affected except for slight additions where a carbide slag is used in the basic process. Deoxidation is the most important result obtained in the electric furnace, and the basic type of lining secures the best results in this direction, while low sulphur which is the hall mark of quality in certain classes of work is obtained through this latter reaction.

Interesting sidelights, not directly connected with the subject of electric furnace melting were developed in the discussion. The theory was advanced that many of the troubles characterized as blow holes in castings may be avoided by supplying sufficient pressure through higher pouring head and hotter metal. The analogy of carbonic gas held in solution in soda water under pressure, but released as bubbles when the bottle is uncorked was applied to the condition encountered in iron which is setting in the mold. It was held that if sufficient pressure is applied while the metal is solidifying, the gases will remain in combination. Deoxidation, which is obtained in the electric furnace, was given as the chief chemical advantage of the electrical process.

Both the morning and afternoon sessions of the opening day were devoted to the subject of corrosion, which is engaging so much attention from the scientific bodies at the present time. A symposium on this subject was held under the chairmanship of Dr. B. D. Saklatwalla, metallurgist Vanadium

He Wets the Coke

TWO foundrymen foregathering in the hotel lobby broached the subject of wet vs. dry coke in the cupola. One told how his melter whenever he found his iron coming down sluggish wet down his coke. The other had the same experience to relate. He explained that the wetting permitted the coke to approach the melting zone before it burned and that he believed that the preheating of the iron was but little affected. He said that the steam lowered the amount of carbon monoxide which came from the top of the charge and he checked this by taking gas analyses about 3 feet below the charging door. The coke burning on the bed gives off carbon dioxide, which as it goes up through the mass of coke above burns the latter and the gas emerging is carbon monoxide. This action is diminished by the steam from the wet coke. The wages of a colored laborer employed to sprinkle the coke in the yard was more than offset by the saving in coke obtained. The colored man does not work on rainy days.

Corp of America, Bridgeville, Pa.

At the meeting held Friday morning, Dr. A. E. White, University of Michigan, Ann Arbor Mich. presented a paper on the use of electric furnace in heat treatment, introducing the symposium of industrial electric heating. The author compared the different types of heat treating furnaces, giving costs of operation, and calculated efficiencies. Scientific heat treatment which is less than 28 years old has been brought to its present state largely through the impetus of automotive manufacturing demand. In one high priced automobile more than 80 different parts receive heat treatment, and many more than one treatment. The merits of electrically heated furnaces or ovens are given by Dr. White as even temperature; accurate automatic control; freedom from gases with attendant elimination of excess scaling and pitting; heating by uniform radiation; better working conditions for the operators; uniformity in product; lower retreatment; lower scrap; ability to locate furnaces closer together. The types of furnaces were divided under the following classifications for description: Box pusher; conveyor car; annular ring or doughnut counter flow; muffle.

In discussing this paper, E. F. Collins, General Electric Co., Schnectady, emphasized the need for taking into consideration all variable factors before making comparisons between the different types of heating applied to heat treatment furnaces.

Report Heating Losses

A paper by F. S. Heath, Federal Mogul Corp., Detroit rounded out the symposium on electricity for industrial heating. In the latter, a unit made by the Detroit Electric Furnace Co., is operated on a number of differenet bronzes. The author reported losses of only 0.6 per cent, with a current consumption of 325 kilowatt hour per ton, 6½ pounds per ton of electrode consumption and a life of refractory lining running from 2000 heats on average operation to 1000 heats on accelerated production.

The industrial heating session was followed in the afternoon by an inspection trip to the heat treating, japaning and foundry departments of the Cadillac Motor Car Co. and the heat treating division Hudson Motor Car Co. in which about 60 participated.

The symposium on electric furnace refractories which reflected the influence of the round table discussions held at two previous meetings of the society, embraced papers on thermal conductivity of carborundum, the preparation of artifical stilimanite and the influence upon refractories of fluorine in deoxidizing slags used in the basic line electric furnace. In the later paper byFrank T. Sisco, McCook Field, Dayton, O., told of the proper use of fluorspar. The spring meeting of the society in 1925 will be held in Niagara Falls, while the fall meeting probably will go to Chatanooga.

Steel Treaters Study Use of X-Ray

ONE of the features of the sixth annual convention of the American Society for Steel Treating held at Boston, Sept. 22-26, was the program of technical sessions. A wide range of subjects was covered by the 45 technical papers, many of the authors being well known authorities on metallurgical problems. Morning sessions were held at the Copley Plaza hotel while the afternoon sessions, which dealt with practical problems, were held at Commonwealth Pier where the exposition of furnaces, metallurgical equipment, steel and machine tools was conducted.

Dr. Kotaro Honda, Imperial university, Japan, was one of the prominent metallurgists who attended the meetings. At the Wednesday morning session he read a paper "On the Transformations of Pure Iron," while at an earlier meeting a paper "The Law of Depression of Freezing Point as Applied to Metallic Alloys," prepared by himself and Toyato Ishigaki, also of the Imperial university, was presented by title. At the banquet on Thursday evening, Prof. Honda was made an honorary member of the society.

A paper of considerable interest was "The Application of X-Ray Crystal Analysis to Metallurgy," by Dr. W. P. Davey, General Electric Co., Schenectady, N. Y. This paper outlined the methods used in applying X-ray crystal analysis as well as the method used in obtaining spectroscopic photographs. Dr. Davey showed how the arrangement of atoms in metals gives a rational explanation of their relative ductilities and how the parameters of the crystal latices in solid solutions give a rational picture of the mechanism of solid solution.

"Sperodized Cementite in Hypoeutectoid Steel," by R. S. MacPherran and J. F. Harper, Allis-Chalmers Mfg. Co., Milwaukee, reviewed the authors' experience in a method of heat treating large forgings. It was found also that the same treatment applied to cast steels gave a corresponding improvement of physical properties. "Progress in the Manufacture and Use of Clay Refractories" was the subject of a paper by W. G. Owens, Haws Refractories Co., Johnstown, Pa.

At the Thursday morning session, Dr. H. H. Lester, Watertown Arsenal, Watertown, Mass., read a paper on "X-Ray Tests Applied to the Problems of the Steel Foundry." Dr. Lester reviewed a number of tests that have been conducted at the arsenal. He said that while this method of testing castings still is too expensive to use commercially it has been the means of determining the best foundry methods to obtain sound castings. V. O. Homerberg, Massachusetts Institute of Technology, Boston, presented a paper "Macroscopic Examination of Steel" at the Friday morning session. The author explained the manner in which segregation takes place in steel and gave the method of preparing the specimens, the formulas of the etching reagents and their particular use.

The Tuesday afternoon program consisted of papers and discussion on various fuels for heat treating furnaces. On Thursday afternoon a symposium was held on hardness testing, an unusual amount of discussion being provoked. A symposium on metallurgical education was conducted on Friday afternoon.

The Henry Marion Howe medal awarded each year to the author of the best paper published in the *Transactions* of the society was awarded for 1924 to F. F. Lucas, Western Electric Co., New York, for a paper "High Power Photomicrography of Metallurgical Specimens." In another paper presented at the convention this year, he read a paper on "The Microstructure of Austenite and Martensite," in which micrographs of 6000 diameters were shown.

At the annual business meeting on Wednesday morning announcement was made that W. S. Bidle, president W. S. Bidle Co., Cleveland, and present vice president of the society had been nominated for president for 1925. Other nominations were: Secretary, W. H. Eisenman, Cleveland; directors, F. E. McCleary, Dodge Bros. Co., Detroit; F. G. Hughes, New Departure Mfg. Co., Bristol, Conn.; and Dr. Paul Merica, International Nickel Co., New York. The election will be held in December. The 1925 convention and exposition of the society will be held in Cleveland, Sept. 14-18, 1925.

Cut to this point

TYPICAL ANALYSES OF MISCELLANEOUS COMMODITIES USED IN FOUNDRY PRACTICE

By J. M. Quinn

Commodity	Ash* SiO_2	Silica SiO_2	Iron Fe	Ferric Oxide Fe_2O_3	Alumina Al_2O_3	Calcium Oxide Ca O	Magnesium Oxide Mg O	Sulphur S	Fixed Carbon C	Manganese Oxide Mn O	Water H_2O	Volatile Matter	Source of Data
MISCELLANEOUS MATERIALS													**MISCELLANEOUS MATERIALS**
Charcoal	2.54	.....	.....	.....	.....	.....	.....	0.058	55.90	.....	14.00	27.56	Rodenhauser, The Elect. Furnace in the Iron & Steel Industry....1917
Charcoal	2.80	.....	.....	.....	.....	.....	.....	.....	74.40	.....	2.20	20.60	Rodenhauser, The Elect. Furnace in the Iron & Steel Industry....1917
Coal—Hard Egg Size	5.66	.....	.....	.....	.....	.....	.....	0.610	88.49	.....	.....	3.52	Stillman, Engineering Chemistry....1910
Coal—Hard Stove Size	10.17	.....	.....	.....	.....	.....	.....	0.570	83.67	.....	.....	4.16	Stillman, Engineering Chemistry....1910
Coal—Hard Fea Size	14.66	.....	.....	.....	.....	.....	.....	0.640	79.04	.....	.....	3.89	Stillman, Engineering Chemistry....1910
Coal—Soft Bunsen	4.93	.....	.....	.....	.....	.....	.....	0.680	47.76	.....	9.92	37.39	Illinois Steel Co., Gary, Ind....1914
Coal—Soft Miami	4.96	.....	.....	.....	.....	.....	.....	0.550	48.23	.....	10.36	36.43	Illinois Steel Co., Gary, Ind....1914
Coal—Soft Elkhorn	3.99	.....	.....	.....	.....	.....	.....	0.630	54.01	.....	10.32	31.68	Illinois Steel Co., Gary, Ind....1914
Coke—Connellsville	10.00	.....	.....	.....	.....	.....	.....	1.000	88.00	.....	.....	1.25	Hickman-Williams & Co., Chicago....1918
Coke—Pocahontas	4.80	.....	.....	.....	.....	.....	.....	0.710	92.54	.....	0.25	1.70	Hickman-Williams & Co., Chicago....1918
Coke—Wise County	10.76	.....	.....	.....	.....	.....	.....	0.500	87.27	.....	.....	1.94	Hickman-Williams & Co., Chicago....1918
Electrodes—Carbon	0.81	0.49	.....	0.12	....	....	....	0.200	98.00	.....	1.19	.....	Barton, *The Iron Age*, Jan. 5....1922
Electrodes—Carbon	0.83	0.12	.....	0.26	0.08	0.17	0.13	.....	99.17	.....	.....	.....	Barton, *The Iron Age*, Jan. 5....1922
Electrodes—Graphite	Balance in Ash of Iron Oxide and Silicon Carbide.								99.00 99.50	.....	.....	.....	Acheson Graphite Co., Niagara Falls, N. Y....1922
Superflake Carbon Raiser	.....	5.00	.....	4.00	3.00	.....	.....	.....	86.00	.....	.....	2.00	Superior Flake Graphite Co., Chicago....1922
Ashes from Bunsen Coal	95.35	.....	.....	.....	.....	.....	.....	.....	4.65	.....	.....	.....	Illinois Steel Co., Gary, Ind....1914
Ashes from Bunsen Coal	91.03	.....	.....	.....	.....	.....	.....	.....	8.97	.....	.....	.....	Illinois Steel Co., Gary, Ind....1914
Ashes from Coke Breeze	.....	40.60	11.60	.....	25.40	5.60	.....	.....	.....	.....	.....	.....	Rodenhauser, The Elect. Furnace in the Iron & Steel Industry....1917

	Oxygen O_2	Carbon Monoxide CO	Carbon Dioxide CO_2	Benzol C_6H_6	Ethylene C_2H_4	Hydrogen H_2	Methane CH_4	Nitrogen N_2	British Thermal Unit BTU				
Gas—Producer from Bunsen Coal	.....	17.9	9.3	.....	0.3	9.7	1.9	.....	106.8	.....	.....	.....	Illinois Steel Co., Gary, Ind....1915
Gas—Producer from Elkhorn Coal	.....	21.0	7.2	.....	0.6	10.7	2.8	.....	132.3	.....	.....	.....	Illinois Steel Co., Gary, Ind....1915
Gas—Coke Oven	0.08	7.8	2.4	0.3	1.7	56.8	24.0	6.2	492.9	.....	.....	.....	Illinois Steel Co., Gary, Ind....1915
Gas—Open Hearth Producers	.....	17.4	8.8	.....	0.6	9.7	2.4	.....	114.2	.....	.....	.....	Illinois Steel Co., Gary, Ind....1915

	Titanium Oxide TiO_2	Silica SiO_2	Ferric Oxide Fe_2O_3	Alumina Al_2O_3	Calcium Oxide Ca O	Magnesium Oxide Mg O	Sulphur S	Fixed Carbon C	Loss	Alkali	Fusion Point	
Nozzle—Fire Clay Ladle (Poor Service)	.....	60.46	1.28	38.22	Trace	Trace	.....	.....	.....	.....	.....	Interstate Iron & Steel Co., Chicago....1920
Nozzle—Fire Clay Ladle (Good Service)	.....	59.80	2.12	37.80	0.22	Trace	.....	.....	.....	.....	.....	Interstate Iron & Steel Co., Chicago....1920
Sleeves—Fire Clay Stopper Rod	1.20	55.64	1.86	26.44	0.25	1.01	.....	.....	11.86	1.12	2894°F	Tempest Brick Co., Pittsburgh....1921
Stopper Heads—Fire Clay	.....	52.20	2.18	43.42	0.40	0.40	.....	.....	.....	1.47	.....	Bureau of Mines, Columbus, O....1922
Stopper Heads—Graphite	.....	21.92	0.91	18.24	0.17	0.17	.....	58.00	.....	0.62	.....	Bureau of Mines, Columbus, O....1922

		Total Carbon C	Manganese Mn	Sulphur S	Phosphorus P	Silicon Si					
Iron Ingot Molds	.....	.....	{0.40 0.90	0.100	{0.100 0.150	{1.75 2.00	.....	.....	.....	.....	The Foundry....1921
Iron Ingot Molds (Direct Metal Blast Furnace Iron)	.....		{0.90 1.10	0.025	{Under 0.150	{1.25 1.60	.....	.....	.....	.....	The Foundry, Feb. 15....1922
Iron Ingot Molds	.....	3.40	0.65	0.060	0.100	1.65	.....	.....	.....	.....	Dyer—*The Iron Age*, Sept. 8....1921

*Ash usually is indicated by Symbol SiO_2 and includes Silica (SiO_2) Alumina (Al_2O_3) Iron Oxide (Fe_2O_3) Calcium Oxide (Ca O) Magnesium Oxide (Mg O), etc.

(*Continued on Data Sheet No. 547*)

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Note—This sheet may be cut along this line and one half folded over on the other to bind in 5 x 7 inch note book.

Do not cut—Fold along this line for binding

THE FOUNDRY DATA SHEET, OCT. 15, 1924

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

BROADWAY 1480

THE STONEY FOUNDRY ENGINEERING & EQUIPMENT CO.

EAST 66TH STREET AND HUBBARD AVENUE

FOUNDRY PRODUCTION SPECIALISTS

CLEVELAND, OHIO

CONSULTING SERVICE ON ALL FOUNDRY PROBLEMS

September 10, 1924.

The Foundry,
Penton Building,
Cleveland, Ohio.

- Mr. J. D. Pease -

Gentlemen:

We enclose herewith copy for advertisement which is to appear in the October 1st issue of THE FOUNDRY. You will note from this that we are bringing out a machine which is radically different from anything that has preceded it, and after careful consideration we have decided that the best way to bring this new equipment before the foundry public is to concentrate all of our advertising in THE FOUNDRY.

This we felt would interest you inasmuch as you are in charge of advertising sales. In reaching this conclusion we considered very carefully the other mediums but felt that the returns obtained through our advertising in connection with the Stoney PATENT Shakeout Bail justified the decision arrived at, as mentioned above.

Yours very truly,

THE STONEY FOUNDRY ENG. & EQUIP. COMPANY

E. S. Cohen

ESC:MO

Wax Is Patternmaker's Friend

Material Secreted by Bees Now Is Used for Making Fillets in the Pattern-shop—A Hard Wax Having Greater Resistance Is Secured by Mixing With Plaster of Paris and Resin

BY WALTER C. EWALT

BEESWAX, often referred to in a jocular manner as the "patternmaker's friend covering a multitude of sins," is a plastic material secreted by bees and used by them to make cells in which to store their honey. The worker bee has eight wax pockets, four on a side under the abdomen, in which the wax is formed.

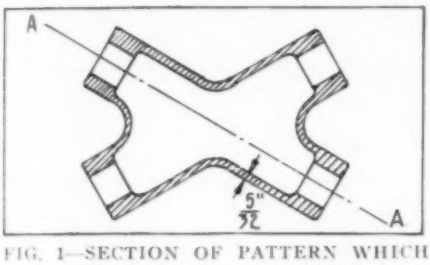


FIG. 1—SECTION OF PATTERN WHICH IS DIFFICULT TO CONSTRUCT

The color of the wax depends on the source of food supply of the bees. It is said that for many centuries beeswax was known as a commercial commodity and was of such great value that taxes, rents and other obligations were paid with wax. Before paper was invented, wax was used to make wax tablets on which temporary records and writings were made. Beeswax has a specific gravity of 0.96 and melts at about 143 degrees Fahr.

Beeswax comes in various grades, the absolutely pure, being the best to use, but also the highest priced. It also is obtained in different grades of so-called commercial wax. The adulterated wax made by mixing beeswax with a vegetable wax is superior to that mixed with parafine or tallow, as it is more pliable and may be worked more easily. The price of adulterated wax is governed by the amount of pure beeswax used. Patternmakers use wax to make fillets in the corners of patterns.

Composition fillets now are on the market which are sold on spools, each spool containing one pound. The fillet comes in the following sizes and radii:

Number	Radius in inches
1	1/16
2	1/8
3	3/16
4	1/4
5	5/16
6	3/8
7	7/16
8	1/2

Beeswax fillets are applied to patterns with fillet tools which usually are made by fastening steel balls of various diameters to the end of a handle. The beeswax fillet is passed through the flame of an alcohol lamp several times to soften it, and then is placed quickly in the corner of the pattern. The wax is pressed into a perfect fillet with the fillet tool of the proper radius, which has been heated in the fire. Wax thus applied will stick to a clean surface whether shellaced or not, and it will be difficult to loosen by rapping. Beeswax also is used to fill up nail and screw holes and small defective places in patterns. Holes of this kind usually are filled with wax after the first coat of shellac is applied.

A hard wax is sold which gives a harder surface to ram against in the mold. A hard wax giving satisfactory results may be made by mixing a cup of plaster of paris and a teaspoon of ordinary resin. The material is heated over an electric stove, oven, spirit lamp or steam pipe and beeswax is added until the mixture assumes the consistency of putty. The degree of hardness is governed by the amount of resin used and any color may be obtained by using the same materials as were used to color shellac, namely vermilion, lamp black, Prussian blue, etc.

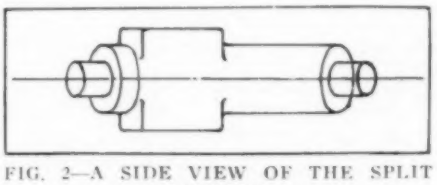


FIG. 2—A SIDE VIEW OF THE SPLIT PATTERN

A convenient electric stove now is on the market in which hard wax may be mixed. The stove contains an electrically heated plate and a vessel which is divided into two compartments by a partition. One compartment contains the pure beeswax and the other side the mixture of hard wax. An alcohol lamp may be used to obtain heat and if desired, a stand may be build to hold the vessel.

Hard wax may be used for the same purpose as the soft wax and may be applied to wood or iron patterns and core boxes with satisfactory results. The wax may be applied easily with tools made from old hack saw blades of different lengths. With these tools the fillets may be formed and scraped to size. For some special kinds of work in patternmaking, molders' wax and prepared clay may be used.

Fig. 1 shows an example of a casting having an irregular shape, making it difficult to build the corebox of the same thickness as the metal, employing the ordinary methods. A side view of the pattern is shown in Fig. 2. An iron corebox may be wanted, so a master pattern is made of wood and a master box of plaster. Both halves of the corebox pattern may be made in the same manner, but only one half of the pattern is shown in the drawings.

Fig. 3 shows one half of the pattern resting on a board. Plaster is poured into the frame surrounding the pattern. In an article which will appear in an early issue, the author will go into more detail concerning the use of plaster. After the plaster sets and is removed from the pattern, and the

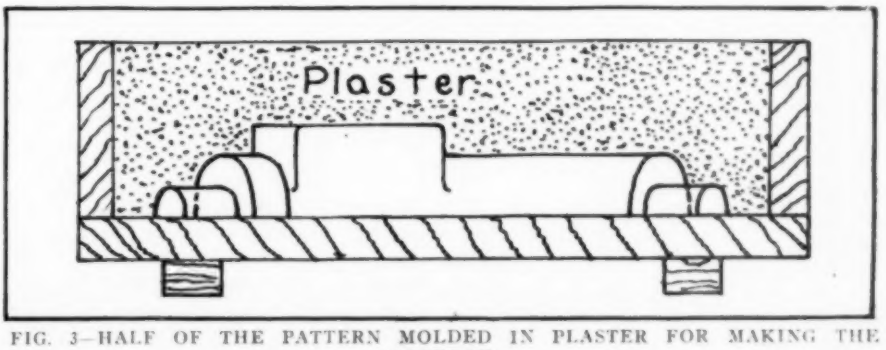


FIG. 3—HALF OF THE PATTERN MOLDED IN PLASTER FOR MAKING THE COREBOX

plaster is lined with wax as shown in Fig. 4. The wax is prepared in a sheet 5/32-inch thick by laying a piece of paper on a flat board and placing a wood frame 5/32-inch thick and 6 or 8 inches square on the inside. After the wax is smelted, it is poured into the frame. The frame is removed when the wax is cool and the wax is cut in narrow strips and laid in the plaster mold. This may be accomplished easily since the wax bends readily.

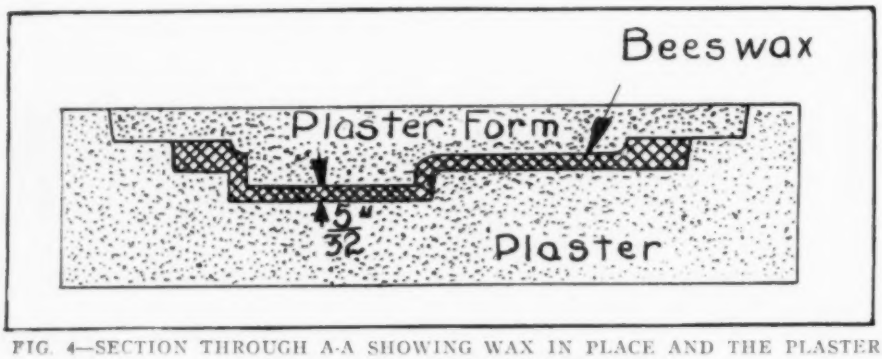


FIG. 4—SECTION THROUGH A-A SHOWING WAX IN PLACE AND THE PLASTER FORM POURED ON TOP OF THE WAX

The joints made by the narrow strips of beeswax next are filled with wax and smoothed off. The plaster form then is poured on top of the wax and that part of the plaster which forms the prints. This makes the plaster form for the corebox. After the plaster is set, it is placed as shown in Fig. 5, and another plaster cast is made which is the master corebox. This case is backed out, as shown in the dotted lines, leaving ribs on the back from each opening toward the center. This gives the iron corebox strength and a level surface on which it rests when the core is being rammed up.

Flange on Vessel Shows Defective Spots

Question: We shall appreciate your opinion on the probable cause of trouble we are experiencing in casting a steel pressure vessel 80 inches deep, 36 inches diameter, 1¼ inch thickness of metal with a flange around the top 5 inches wide and 3 inches thick. The casting apparently is perfect when it is taken out of the sand, but the first cut in the machine shop taken over the face of the flange reveals numerous cavities. Under the belief that these were due to cooling strains we thickened the flange and placed a heavy fillet at the junction line between the flange and the remainder of the casting. This treatment had no effect. We have decided to make the casting in two parts, the body and flange, and afterward screw one to the other. Are these castings made as a unit in any foundries with which you are familiar.

Answer: You do not describe the characteristics of the cavities and therefore we cannot state positively their direct cause. They may be due to gas in the metal, to gas from the core, to steam from the mold, to shrinkage owing to inadequate feeding heads, or to the mold yielding to the pressure of the metal. A close examination of the cavities usually will supply a competent foundryman with sufficient evidence on which to base an opinion of the underlying cause.

If the holes are due to a *cold* heat, they will be found all through the casting. If they are due to gas from the core they will be found in greater profusion in the vicinity of the core than elsewhere, particularly around the top. If they are caused by steam from a damp mold they usually will contain a certain amount of dirt washed up with the metal. If they are traceable to shrinkage they will present a characteristic drawn or torn surface that cannot be mistaken for anything else. These castings are made satisfactorily in the following manner.

The mold is thoroughly dried to prevent the generation of any steam. The castings are poured through a gate at the bottom while the mold is in a vertical position and four 12-inch diameter sink heads are provided on the upper side of the flange. The metal in these sink heads will compensate for the normal shrinkage. Sometimes the mold yields to the pressure of the metal and the body of the casting draws away more from the flange than the heads may supply. In extreme cases the loss is quite noticeable. At other times the defect takes the form of draw or crack, or simply as porous area that remains concealed until the casting is subjected to an internal pressure test. A complete description of the manner in which hydraulic steel cylinders for rubber plants are made was published in the May 1, 1920, issue of THE FOUNDRY.

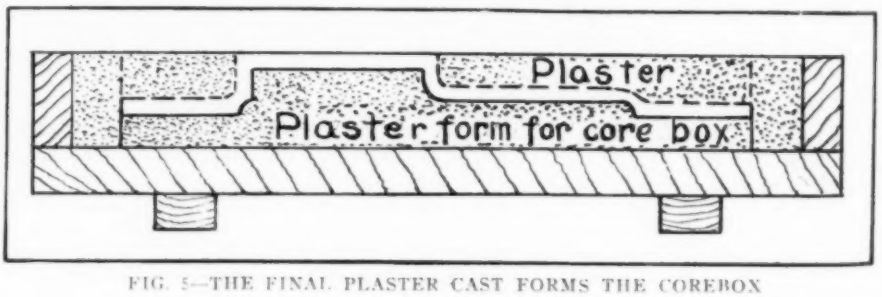


FIG. 5—THE FINAL PLASTER CAST FORMS THE COREBOX

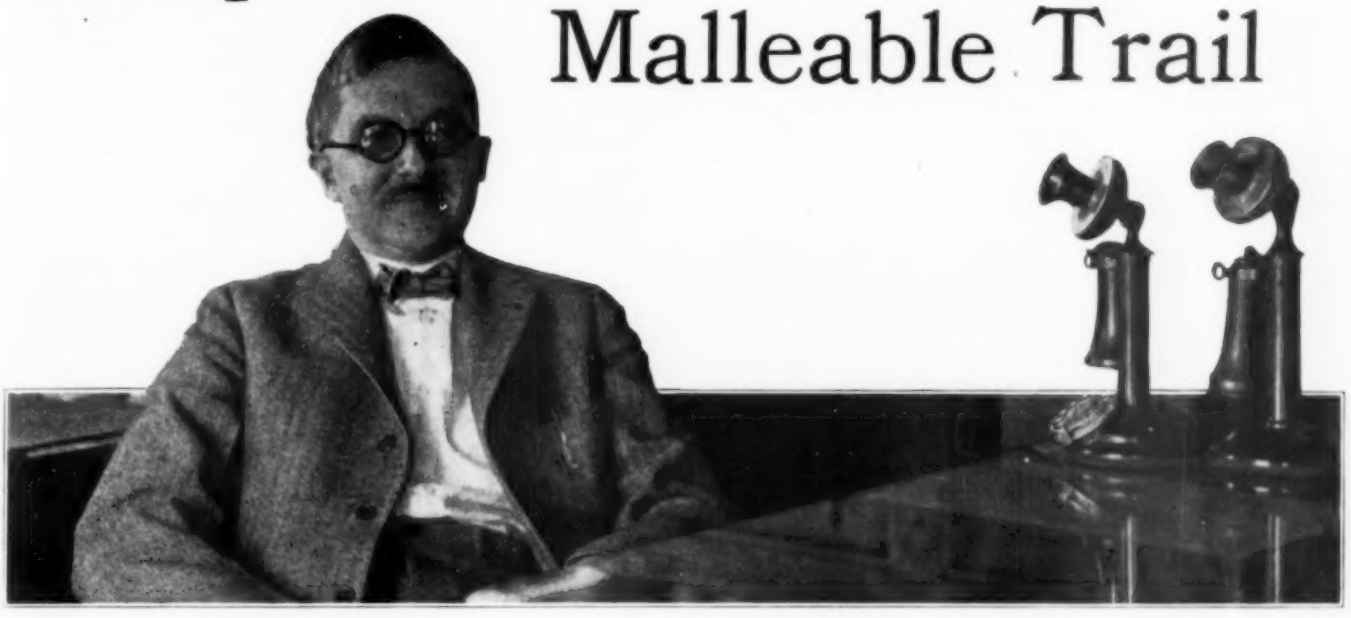
Manganese Copper Aids Bronze Mixture

By W. B. Jones

Life of bearings may be increased by the addition of a small quantity of manganese copper to the mixture. It should be reduced with copper and grained in water to facilitate the addition in small quantities. Instead of using ½ pound of 30 per cent manganese copper it is preferable to reduce the alloy to a 5 per cent manganese copper and use ½ pound of that alloy. For years the writer has made brake bands for an automobile manufacturing company from a mixture containing 7½ parts copper to 1 tin with 2 per cent zinc and ½ pound reduced manganese copper. Wrist pin bushing were cast from the same metal. They consumed a little more time in finishing than the usual alloys employed for the purpose, but they gave infinitely better service. Elevator gears that withstood severe and long service also were cast from the foregoing mixture. To test the value of manganese copper as a strengthening agent several automobile bearing bushings were poured from a standard bearing metal. Other bushings were poured from a mixture containing a small percentage of manganese bronze. After the machine had covered a distance of 20,000 miles the first bushings were worn out while the second were polished and shining like a mirror.

Usually a quantity that only shows up as a trace in the analysis is sufficient. The alloy has a tendency to darken the skin of the casting. Care should be observed in reducing this alloy to prevent it from absorbing gas from the fuel. It should be covered with charcoal, then stirred, skimmed and poured into water.

Camped for Years on the Malleable Trail



H. A. SCHWARTZ after devoting the greater part of 20 odd years of his life to an investigation of malleable iron with a view to writing a treatise on the subject after the manner of the late Mr. Walton's *Compleat Angler*, finally decided that as his chance of emulating Methusaleh was rather slim, he had better set down the result of his investigations up to date and take up additional points as they arose up to the time the lamp of life finally flickered out. The result of his decision is *American Malleable Cast Iron*, a book of 400 pages dealing apparently with everything connected with the industry from a historical sketch in the beginning to a highly scientific discussion at the close, of fatigue, plastic deformation and thermal and electrical properties. The book is unique in that with a single exception, now out of print, it represents the only book of its kind ever written. Before sinking into the scientific depths where the book was written, also at various times during its preparation when the author one might say came up for air, H. A. contributed many papers dealing with metallurgical subjects to the technical press.

His principal field of work has been the study of graphitization which has engaged his continuous attention for the past 12 years. Naturally this subject did not engage his entire attention. He filled out a fairly comprehensive program by studying problems dealing with the machinability of ferrous materials, properties of molding sands, factors affecting foundry costs, properties of molten iron, electro-magnetic properties of castings, thermal conductivity, frictional wear and many others of less permanent interest. With a view to taking up the slack and filling in his spare time, he became a member of the following associations: American Society of Mechanical Engineers, American Society of Mining and Metallurgical Engineers, American Chemical society, American Foundrymen's association, American Society for Testing Materials, American Society for Steel Treating, American Society of Automotive Engineers, British Iron and Steel Institute, Cleveland Engineering society. He also finds time to do a little photography, automobiling, and attend grand opera. He is adding continually to the list of his activities and hopes eventually to reach a stage where his time will be fully occupied. At one time he indulged in amateur theatricals as a form of recreation, but since taking part in the celebration which marked the centennial of the founding of Indianapolis a few years ago he has retired from the footlights. Oh! yes, it is a quite natural question. He retired voluntarily.

Mr. Schwartz was born near Louisville, Ky., April 13, 1880 of mixed German and Huguenot French descent. His maternal grandfather who served as a medical officer with the Union forces during the American Civil war, came from near Wartburg in the Thuringian valley the scene of Wagner's first presentation of Tannhauser and this may account in some measure for the leaning toward grand opera which afflicts his grandson. However, the case for heredity vs. environment is somewhat weakened by the further disclosure that although practically all his male relatives on both sides of the house for many generations have practised medicine and been regarded as members of the learned professions, he deliberately chose to enter industrial life to find out what made the wheels go around.

He was educated in the public schools of Louisville and the Rose Polytechnic institute, Terre Haute, Ind., where he secured his B. S. degree in 1901, M. S. in 1903 and M. E. in 1905. After graduation he spent two years in calmly contemplating the industrial field and in deciding whether he should tackle it from the front or the side. The front view was taken from the inside of a power plant where he toiled the first year. The side view was had from the class rooms of Rose Polytechnic institute where he taught during the second year. Then he entered the office of the National Malleable Castings Co., Indianapolis as a designer.

The late A. S. Bixby, at that time superintendent of the plant decided to build and equip a laboratory for research purposes and works control. He consulted his old friend Dr. William A. Noyes, University of Illinois, on the subject of securing the services of a competent man and the doctor promptly suggested the name of the young designer who had taken special chemical work under him. The laboratory was designed, built and placed in operation in 1903 and for six years thereafter was engaged in work involving metallurgical development and experiment.

In 1909 Mr. Schwartz was appointed assistant superintendent of the plant where his duties were mainly in connection with the metallurgical engineering and new designing features of the works. Four years later while still retaining his active connection with the plant in

(*Concluded on Page 829*)

THE FOUNDRY

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Provides Source of Information

IN THESE modern days with their hurry and bustle, with their multiplicity of papers, magazines and periodicals of every description, the average man is at a loss to find time to more than skim through half the literature that passes daily through his hands or over his desk. He may have the best intentions in the world, but probably the most familiar saying in the English language is the one concerning good intentions. Without doubt it is utterly out of the question to read everything, but ordinary common sense would seem to indicate that a man at least should attempt to keep posted on everything that exerts a bearing directly or indirectly on the business in which he is engaged and in which he expects to continue indefinitely.

The various factors entering into industrial life constantly are in a state of transition. Practice that apparently is up to the minute today may be obsolete tomorrow. Current literature along any line of industrial life is the only available index of its progress and the man who advances and whose business prospers is the man who is posted and therefore in a position to remain in the vanguard.

What a man takes in is in proportion to what he gives out and the measure of his interest in a subject depends to a great extent on the degree to which he is brought into contact with others engaged in a study of the same or closely related subjects. Physical contact is not an actual necessity. Mental contact is all that is required and the only way to maintain a live mental contact with the active spirits of the foundry industry is through the printed word reflecting their views and opinions.

Through its outstanding position in the casting field THE FOUNDRY attracts contributions from men eminent in the industry and is in a position to present their views, the result of their experience and the fruit of their researches before the immense number of men engaged in the production and sale of castings and of the almost equally large number of people engaged in the production of foundry supplies and equipment. A careful perusal of its pages is an inspiration, an education and in many instances a fair measure of the interest taken in the subject by the reader.

Once a year the American Foundrymen's association holds a convention and exhibition. This association is purely technical in character and is interested primarily in the advancement of the industry from a technical and scientific standpoint. At the convention, technical papers are presented on various subjects and are discussed at the various meetings. Foundry equipment and supplies are displayed for the benefit and edification of visiting foundrymen.

THE FOUNDRY presents technical papers not once a month but twice a month, every month in the year. The papers presented at the convention are presented also in the columns of THE FOUNDRY and in addition hundreds of special articles on every phase of the multi-sided foundry problem are available through the same medium. The list of materials described in the advertising pages of THE FOUNDRY far exceeds anything of the kind ever shown at any exhibition. This is a more or less natural condition and applies to practically every periodical devoted to the interests of the technical field. Where the copies are kept and filed they not only serve their immediate purpose in presenting information at the moment that it possesses news value, but they also serve indefinitely as a ready reference, and encyclopedia of information.

Trade Outlook in the Foundry Industry

MORE tangible evidences of improvement in general business and industrial outlook are noted with the advance of fall. Rising farm product prices promise better buying in farming communities. Building construction, although somewhat restricted, is highly satisfactory for the period of the year. Railway car orders are on the increase. Blast furnace operations indicate improvement in pig iron sales. Freight car loadings continue to advance. Demand and production of soft coal are increasing steadily. Automobile production continues to be satisfactory. Foundry operations show signs of improving and castings inquiry is more active.

Rail Orders Mount

For the past several months, orders for railway equipment and especially freight cars have continued to advance. The total number of cars ordered in July was only 886. This advanced to 5984 in August and the September total mounted to approximately 25,000 cars, the largest single month for the year with the single exception of February with its exceptional record of 41,000 cars. During the first week of October the total of orders placed approached 8000, while inquiries continue strong. It is said that more than 25,000 additional cars are being considered for early purchase. Further, locomotive orders have commenced to improve and September was the first month since February to show an increase in the total of unfilled orders, according to the department of commerce. Surplus cars, according to reports made to the American Railway association, are declining each week. The total of idle cars on Sept. 14 is given as 167,157, a decrease of 27,149 compared to the previous week. In the seven day period ending Sept. 20, new high records in loading were established. The total of 1,076,553 cars was the greatest ever recorded in a single week, with the exception of one week last year.

Prices for Raw Materials for Foundry Use

CORRECTED TO OCT. 8

Iron			Scrap	
No. 2 Foundry, Valley	$18.50 to 19.00		Heavy melting steel, Valley	$17.25 to 17.50
No. 2 Southern, Birmingham	17.50 to 18.00		Heavy melting steel, Pitts.	18.00 to 18.50
No. 2 Foundry, Chicago	20.50		Heavy melting steel, Chicago	16.00 to 16.50
No. 2 Foundry, Philadelphia	20.76 to 21.26		Stove plate, Chicago	17.00 to 17.50
No. 2 Foundry, Buffalo	19.00 to 19.50		No. 1 cast, Chicago	19.00 to 19.50
Basic, valley	19.00 to 19.50		No. 1 cast, Philadelphia	18.00 to 18.50
Basic, Buffalo	23.00 to 23.50		No. 1 cast, Birmingham	14.00 to 15.00
Malleable, Chicago	20.50		No. 1 cast, Buffalo	17.00 to 17.50
Malleable, Buffalo	19.00 to 19.50		Car wheels, iron, Pittsburgh	18.50 to 19.00
Coke			Car wheels, iron, Chicago	17.75 to 18.25
Connellsville foundry, coke	$4.00 to 4.60		Railroad malleable, Chicago	17.25 to 18.00
Wise county foundry, coke	4.50 to 5.00		Agricultural mal., Chicago	16.50 to 17.00
			Malleable, Buffalo	18.00 to 18.50

Jobbing Improves

Orders for miscellaneous castings continue to improve, according to reports from different sections of the country. In the St. Louis district the railway shops are particularly active, while the stove and implement foundries report increased business. Increased production is noted by jobbing foundries in New England. Automobile castings plants in Ohio, Michigan, Illinois, Indiana and Wisconsin report improved inquiry with an advanced rate of operation. In the South, according to the Southern Metal Trade association, 10 foundries report business good, 25 report fair and 10 note poor business. Of these same members, 16 expect an improved rate of operation in 90 days, while 24 look for fair business and 9 are not so hopeful. The stocks of raw materials are reported as increasing during the last 60 day period. The Ohio State Foundrymen's association reports its melt for August as 54.2 per cent of capacity, compared with 62.5 per cent in July. However, improvement has been observed since the first of September. Stocks of pig iron and coke on hand increased slightly in August, although the raw materials received had declined slightly. August showed a percentage of 87 for the stocks on hand at the time the report was issued.

Pig Iron Totals Grow

According to *Iron Trade Review*, blast furnace operation showed an improvement in September. The total output of all grades of pig iron is given as 2,053,617 tons, compared to 1,882,986 tons for August. A comparison on a daily average basis shows that 68,454 tons of iron per day was produced in September, and 60,741 tons per day in August, giving an increase of 7713 tons or 12.8 per cent. The total of merchant iron produced in September was 518,017 tons, compared with 465,059 tons for August, giving a gain of 52,958 tons. On a daily average basis, the September rate is 17,267 tons per day, that for August is 15,002 tons and the gain is 2265 tons per day or 14.7 per cent. The total number of blast furnaces in operation on the last day of September was 174 compared with 150 on Aug. 31. Malleable castings production showed improvement in August for the first time since last March, according to statistics compiled by the department of commerce. A report from 113 identical plants shows the rate of operation to be 32.4 per cent for August, compared to 28.3 per cent for July and 31.6 per cent for June. Orders booked also increased, the total for August being 31,266 tons compared to 27,936 for the previous month and 21,119 tons for June. Production still is slightly in advance of orders received. Orders for cast-iron pipe continue satisfactory, and some rush, immediate-delivery inquiries are extant. Demand for sanitary ware continues active. During August, according to the department of commerce orders for 90,955 bath tubs were received, 101,927 were shipped and unfilled orders totaled 154,659, compared to 169,394 for the latter total in July.

Nonferrous Operation

Brass foundry operations show slight improvement, particularly among those shops making machinery brasses and automotive sundries. Prices on nonferrous metals, according to the *Daily Metal Trade* of Oct. 8, follow: Castings copper, 12.62½c; electrolytic copper, 12.87½c; lead, 8.00c; Straits tin, 49.50c to 49.62½; antimony, 11.12½c; nickel, 33.00c; aluminum, remelt No. 12 alloy 21.50c to 22.00c. Zinc is 6.20c, E. St. Louis, Ill. Average monthly prices for September follow:

(New York Quotations)

Copper Casting	Copper Electrolytic	Lead	Straits Tin	Antimony	98-99 Aluminum	St. Louis Zinc, E.
12.889	13.196	8.041	49.100	8.00	27.00	6.19

Personal

Graham T. Johnson now is treasurer and assistant manager of the Springfield Facing Co., Springfield, Mass.

Thomas Drever, comptroller of the American Steel Foundries, Chicago, has been made president of the Wahl Eversharp Pencil Co., Chicago.

Frank W. Brooke, chief engineer of Wm. Swindell & Bros., Pittsburgh, addressed the Philadelphia Foundrymen's association Oct. 8 on "The Latest Development in Electric Steel Melting."

Thomas I. Curtin, president of the Waltham Foundry Co., Waltham, Mass., spoke before the Kiwanis club at Waltham on Sept. 25 of the "Problems of a Foundryman." He gave a demonstration of the method of making a casting, starting with the pattern.

Dr. Hermann Saemann, Eisen-Stahlwerke, formerly G. Fischer, Schaffhausen, Switzerland, sailed for his home, Oct. 4, after having completed a tour of the leading foundry centers of the United States studying electric steel casting production methods.

Reduces Radiation

Experiments performed by Dr. W. W. Coblent of the bureau of standards indicate that the heat radiated from an aluminum painted radiator surface is less than a third of that emitted by a radiator of the same size painted with a nonmetallic paint, enameled or allowed to rust.

Foundry Is Sold

The Reliable Pattern Works, Cincinnati, has been sold to the Reliable Pattern & Castings Co. The plant is to be moved to 2822 Spring Grove avenue.

Appoint Representative

The Hanna Engineering Works, Chicago, now is represented in the eastern portion of the province of Ontario, the provinces of Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Can., by Williams & Wilson, Ltd., Montreal, Can.

Purchases Plant

The Penn Steel Casting & Machine Co. plant at Chester, Pa., has been purchased from the Penn Seaboard Corp. by a group headed by former Governor Sproul. The men involved in the transaction with Mr. Sproul are John Cosgrove, Johnstown, Pa.; and Frank Finsthwaite, M. H. Furlaud, E. Richards and Howard F. Hansell of New York. The purchase price was not made public.

Thomas Leisk Dies

Thomas Leisk, foundry superintendent of the Bush-Sulzer Bros. Diesel Engine Co., St. Louis, died at his home in that city on Sept. 22 of heart disease after a brief illness. Mr. Leisk had an interesting career and was well

THOMAS LEISK

known to many men in the foundry industry. His early experience was obtained in the plant of the Allis-Chalmers Mfg. Co., Milwaukee. He was foundry superintendent for 15 years of the Power & Mining Machinery Co., of the old Cudahy works of the Worthington Pump & Machinery Corp. Mr. Leisk found ample opportunity to develop his progressive ideas in the production of highly specialized castings required in diesel engine building, especially of the light weight submarine type, and his work has contributed much toward the advancement of the art. Interment took place at his old home in Milwaukee.

Installing Equipment

The Cadillac Malleable Iron Co., Cadillac, Mich., is installing powdered coal equipment and constructing a foundry addition which will increase its capacity about 40 per cent.

Nonferrous castings and machinery fittings other than copper, brass and statistics compiled by the department of commerce.

Blast Volume the Only Important Factor

Question: Experiments conducted by the bureau of mines indicate that a thickness of 22 inches of incandescent coke in a cupola will extract all the oxygen from the correct amount of air delivered. On that assumption would not a bed of that thickness be sufficient irrespective either of the pressure or velocity of the blast. We shall appreciate your opinion on the probable cause of the variation observed in the operation of two 72-inch cupolas. The charging door of the first cupola is located 12 feet above the tuyeres and a blast pressure of 8 to 10 ounces is employed to melt the iron. In the second cupola the charging door is 20 feet above the tuyeres and a blast pressure of 18 to 20 ounces is used. The tuyere area practically is identical in both cupolas and the two blowers deliver the same volume of air.

Answer: A blast pressure of 20 ounces on a cupola is abnormal and we are inclined to the opinion that a new recording device or water gage is required. A definite amount of air is required to consume a definite amount of iron. The pressure or velocity has no direct bearing on the problem. The faster the air is introduced the faster the iron will melt, up to a certain point. After that point has been reached the excess air is detrimental in that it cools the iron and passes up the stack without delivering up its oxygen. The manner in which material is charged in a cupola provides such a porous structure that a 20-foot stack charged to the door offers no more resistance than a 12-foot stack to the free entry of the blast. Volume of air is the important factor, pressure and velocity merely are incidental. In other words to secure the volume you must have pressure and velocity, but you cannot base any calculation on them.

Pattern Works Expanded

The Newark Pattern Works, 39 Avenue L, Newark, N. J., is at the present time engaged in the construction of larger quarters directly opposite its old plant. The new plant is 60 by 120 feet of brick and steel construction. In addition to manufacturing a complete line of wooden and metal pattern equipment including flask, the company is specializing in the manufacture of aluminum match plates.

The Howard Stove Co., Beaver Falls, Pa., has awarded the Austin Co., Cleveland, construction contract for a steel frame building 50 x 100 feet for manufacturing stoves. The engineers are designing the building for a future second story.

Camped for Years on the Malleable Trail

(*Concluded from Page 825*)

Indianapolis, he was appointed metallurgical engineer for the entire corporation which operated plants in Indianapolis, Cleveland, Chicago, Toledo, O., Sharon, Pa., Melrose Park, Ill., and East St. Louis, Ill. During the years immediately preceding the war he was engaged in standardizing the company's metallurgical practice and product in the various plants. Also during this time he was in intimate contact with the development of triplex process for making malleable iron invented by W. G. Kranz, vice president and practiced at the Cleveland plant of the corporation.

He was fairly busy during the period the United States was engaged in the war. With his regular duties as metallurgical engineer of the corporation he combined those of acting superintendent of the Indianapolis plant. He carried on experiments in the manufacture of semisteel shell and co-operated with the sales department along technical lines in adapting malleable iron castings for various purposes hitherto considered outside its field. In 1919 he initiated a policy tending toward a crystallization of the corporations research activities which culminated in the erection and equipment of a building for the purpose in Cleveland where as manager of research he has maintained his office since that time.

Method for Jointing a Branch Core End.

By James Edgar

For various reasons it is not always convenient to attach a branch to the main corebox for a valve pattern. The pattern may be designed to serve for right and left hand castings. A casting may be ordered in a hurry and while a box may be available for the main core it may be necessary to provide a box for the branch core. Usually the patternmaker supplies a frame with square ends and a strike or sweep, from which the molder is supposed to form the core on a plate. After the core has been dried the molder has to cut and try the end of the core until he achieves a passable joint where it touches the main core.

Where a special corebox is made it is relatively easy to shape the end and supply a stripe by which the coremaker can secure an exactly fitting shape, but usually this takes too long. A core straight and round in cross section may be dropped into a framed box with straight ends and a clip made satisfactorily. This course is not practical with a bent branch.

Time is saved in the foundry where the patternmaker provides an accurately fitting shape. In making cores of this character the patternmaker has to decide whether it is advisable to use a plate in preference to a frame. Where several cores are needed the frame method is the more rapid of the two. The cores may be swept on any convenient plates and several may be dried at one time instead of waiting until each core is dried before starting another one. The open frame also provides the most convenient method for developing a special shaped end on the core as shown in the accompanying illustration.

The bend is swept with a strike swinging from a center pin. The short straight part of the bend at each end is swept by a strike working in the guides shown. A block the same contour as the main core is screwed at one end of the frame. It is screwed from the top and in case where the frame is not reversible, that is, where two half cores made from the same frame will not match when pasted, the block easily may be shifted from one end of the frame to the other. Also since it is detachable it may be removed after the sand has been shaped and before the frame is taken from the plate. This is an easy and convenient method for giving any desired shape to the end of a core and in addition it has the advantage that the block may be changed quickly to suit varying coreboxes.

Describe Stacked Molds

To the Editor:

Pat Dwyer's article No. 4 on stacked molds is a good description of a molding machine we are using on water meter tops, small pulleys, flanges, conveyor hangers, etc. Our foundry, as is usual with most foundries, lacked floor space and also money to buy flasks. We conceived the idea of making the molds as described, using a hinged locking ring for a flask.

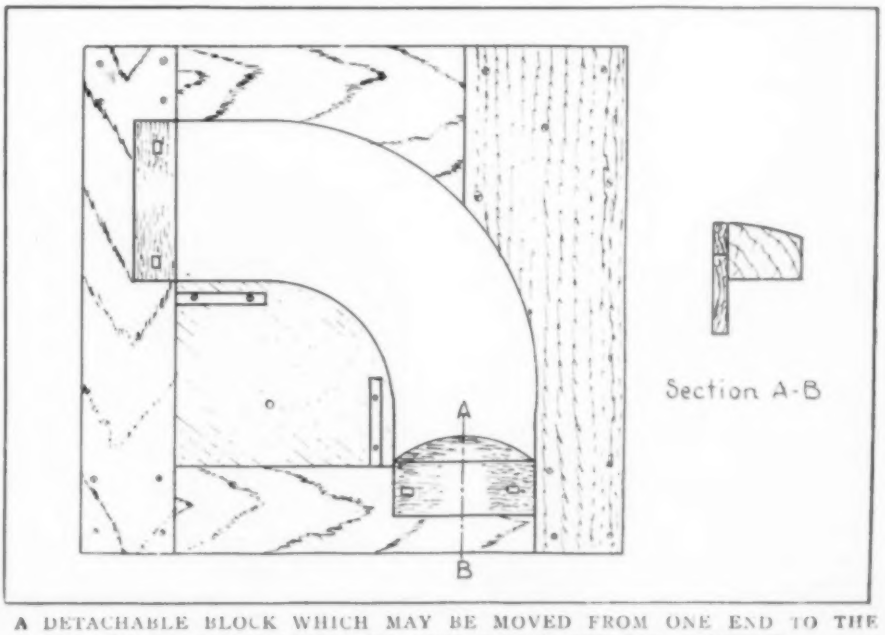
We stack our molds eight high giving seven complete molds per stack. Some of the pattern plates contain four patterns so that production per floor space is high. We tried perforated sheet metal jackets on the stacks of molds but not as satisfactory as the solid sheets, due to an occasional run out burning onto the perforation. The jackets of course are open on one side and clamped in place.

To stack the molds properly without offset or shifts we use a metal frame on which the guide bars are square with a strike off ring at the bottom inside of which the bed of sand is rammed. The guide bars correspond to the guide pins on the table of the molding machine and when a stack is completed the frame is moved to the next space and a new bed rammed.

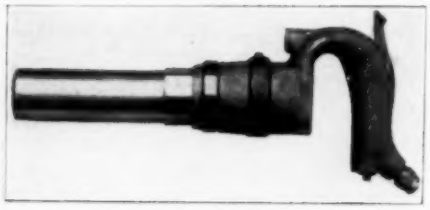
Aluminum patterns are used and we find a little more draft is necessary for this machine than on patterns for hand work. We have a vibrator on the lower half pattern but can not say it helps much.

We have read THE FOUNDRY for a good many years and have gathered a lot of pointers from it, the chief one of which is that we do not know all about the foundry business.

Jess M. Totten.
Washington Iron Works,
Sherman, Texas



A DETACHABLE BLOCK WHICH MAY BE MOVED FROM ONE END TO THE OTHER IS EMPLOYED TO GIVE THE NECESSARY CONTOUR TO THE END OF THE CORE



HAMMER HANDLES LIGHT AND HEAVY WORK IN THE FOUNDRY

Designs New Foundry Chipping Hammer

The Independent Pneumatic Tool Co. Chicago, recently has introduced a new line of chipping hammers especially designed for foundry work. The valve and the valve, which is of the spool type, is enclosed to prevent the entrance of dust. The foundry hammers are round and have a saw tooth locking device for the hanrdle. The handle is provided with saw teeth and a lock ring with corresponding saw teeth and adjustments of the barrel and handle may be made at any point by placing the lock ring in the closest corresponding saw tooth space within the handle. This line of hammers is designed for both light and headvy work and for high speed operation the bore being 1 1/8-inch.

TRACTOR MAY BE USED TO HANDLE TOTE BARRELS

Elevator Tractor Picks Loads from Floor

A new type of elevator tractor designed to pick up or place loads directly on the floor, and having little clearance between the floor and the support, recently has been introduced by the Elwell-Parker Electric Co., Cleveland. The elevator head at the forward end may be equipped with two or more forks at the floor line, 1 or 2 inches thick, and of the proper spacing and length to handle sheet tin, steel plate, bales, boxes, barrels, car wheels, receptacles in heat treating, etc. The truck may be used to handle tote barrels if fitted with a pair of arms 18 inches above the floor as shown in the accompanying illustration. When provided with a single horizontal shaft it serves in handling a number of wheels. In this case the shaft is thrust horizontally between the spokes of the wheels which are placed on their rims at right angles to the truck.

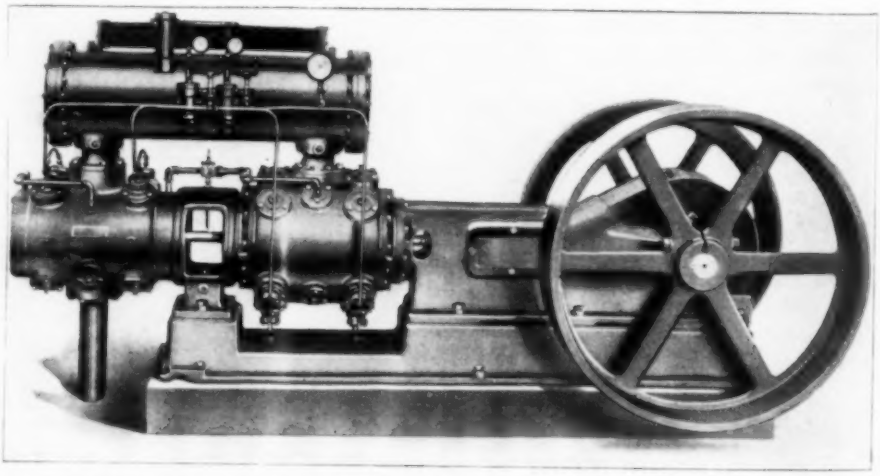
The special hoist is immediately in front of the operator and consists of an enclosed motor and electric brake. The motor drives through a bevel and worm gear reduction enclosed in an oil filled housing and to a single grooved drum grooved for 3/8-inch plow steel cable. The cable leads over a sheave at top of the elevator uprights to the traveling elevator head, which has special attachments to support the load handled. The elevator head is guided by four special shaped rollers running inside the upright channels. The upper and lower pair of flanged rollers are keyed to cross shafts turning in long bronze-bushed bearings in the elevator head. The hoist motor is operated through a controller at the right of the drivers seat. The motor is stopped automatically at the upper and lower limits of travel, or may be controlled manually. The overall length of the unit without the lift attachment is 78 inches, the height 70 inches and the width 30 inches. The weight with the battery is 4300 pounds. This elevator tractor combines the maximum strength and power with minimum lightness.

Use Tandem Construction on Air Compressor

The Chicago Pneumatic Tool Co., New York, has designed a motor-driven air compressor which operates at 275 revolutions per minute, has a piston displacement of 360 cubic feet of free air per minute with air pressures ranging up to 125 pounds. The machine may be driven by belt or by synchronous motor with the rotor mounted directly on the compressor crankshaft.

Tandem construction is used in this unit in which the low pressure cylinder is placed next to the frame and the high pressure cylinder is connected to the low pressure cylinder by a tandem piece through which the piston rod boxes are accessible. The intercooler is mounted above the two cylinders, and the entire unit is mounted on a substantial base. Regulation of the volume of air and its pressure is entirely automatic and may be furnished to conform to the special conditions of the demand for air. When the air demand is fairly constant for periods of the day with intervening periods in which there is slight or no demand, and the compressor is driven by an electric motor, automatic start and stop control operation may be employed, in which case the unit is equipped with a centrifugal unloader which causes the automatic unloading inlet valve to be held open during the period when the compressor is at a standstill and to remain open until, in starting the machine, the compressor has approached normal speed. During the slowing down period prior to stopping, the load is thrown off the compressor.

Carl A. Moore, formerly with the United States Reduction Co., East Chicago, Ind., has become manager of sales for the Aurora Refining Co., Aurora, Ill., with offices at 736 S. Michigan avenue, Chicago.



COMPRESSOR MAY BE DRIVEN BY BELT OR MOTOR MOUNTED ON THE CRANKSHAFT

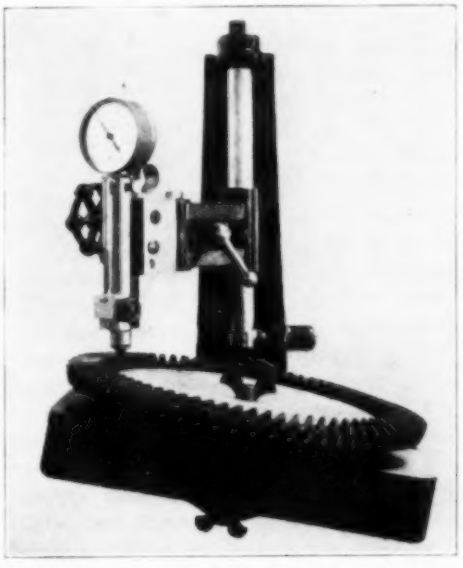
Designs Air Furnace for Small Plants

A direct fired furnace unit heater for use in small shops, warehouses storage rooms, etc., where steam is not available, has been introduced by the Buffalo Forge Co., Buffalo. The furnace, which is shown in the accompanying illustration, is of the standard hot-air type with a galvanized steel casing. The hot-air outlet is at the top. A special feature of his casing is the series of baffle plates which keeps the air in intimate contract with the fire pot. The fan supplied with the heater is driven by a totally enclosed motor which obtains power from a lighting or power circuit. Where possible it is recommended that the heater be installed near the center of the room and the heated air blown at an elevation sufficient to avoid drafts. The heaters are made in two sizes.

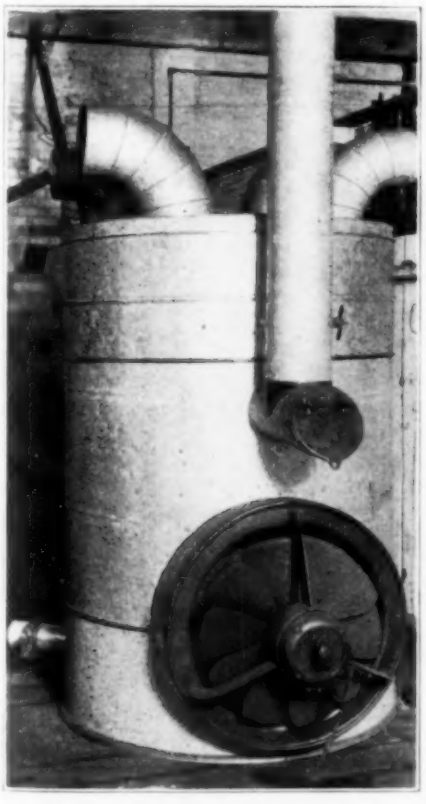
Improves Tilting Base for Hardness Instrument

A stationary scleroscope set manufactured by the Shore Instrument & Mfg. Co., Jamaica, N. Y., as shown in the accompanying illustration, is a combination of a fixed clamping stand and separate swing arm and post with the company's standard scleroscope outfit. The object of the combination is to enhance its range of adaptability to accommodate the increased size, specimens incident to large work. The heavy, graduated, tilting table may be set at any angle with a large removable center anvil for specimens that extend through. It has ball bearing swing arm rigid enough to permit clamping down of specimens. A swing arm may be set in any lateral or vertical position with elastic return to lateral setting. It eliminates the necessity for special holding fixtures required for mass production testing of odd shaped pieces.

The scleroscope fitted onto this machine is the same as used in the portable set, with which its dovetail bar is interchangeable.



TILTING BASE AND CLAMPING SWING ARM DESIGNED TO FACILITATE SCLEROSCOPE USE

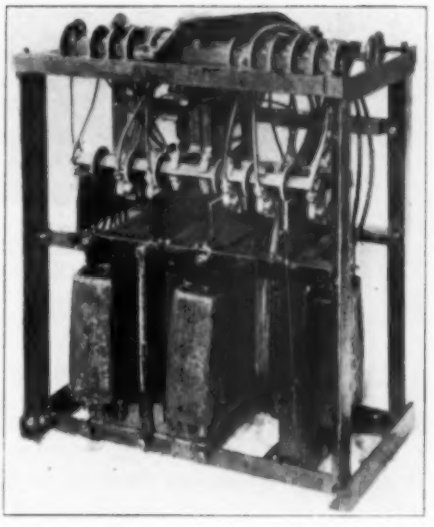


SPECIAL FAN FORCES THE AIR THROUGH THE SHOP

Builds New Compensator

An automatic high voltage compensator has been placed on the market by the Electric Controller & Mfg. Co., Cleveland. The compensator is built for voltages of 2500 or below and is push button operated and entirely automatic. With the exception of the overload panel, which is mounted on top of the tank, the compensator is submerged in oil and the tank is designed to prevent the entrance of dust, dirt, moisture and fire. It may be installed either indoors or outdoors. A push button is operated by an independent low voltage circuit which is taken fro man independent transformer so that the operator is in no danger through coming in contact with the high voltage circuit.

The automatic compensator is so designed that continuous torque is applied to the motor from the time the push button is pressed until the motor has been brought up to speed. Operating the starting switch causes the motor to be started under reduced voltage obtained from transformers in the compensator and after the motor has reached the proper and safe speed it is automatically thrown across the line of the compensator.

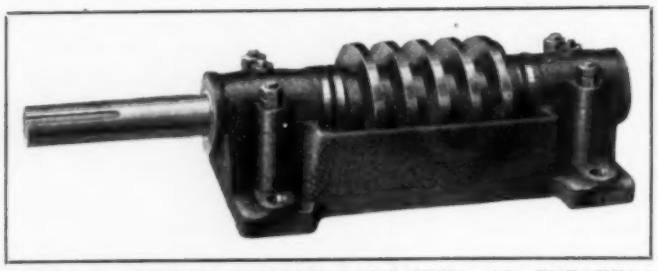


COMPENSATOR IS REMOTE CONTROLLED

Protects Crane Machinery

The Pawling & Harnischfeger Co., Milwaukee, now is equipping its ½ and ¾-yard excavators with a specially designed all steel cab, which protects the main machinery against inclement weather and tampering. The cab has windows on each side of the operator, the windows being protected by sheet steel covers which may be slipped into place when the machine is not in use. A swinging steel door at each side of the machine gives access to all of the machinery. A rolled sheet cover is placed over the drums and gears with a narrow slot for the cables to lead through. The machine, which is shown in the accompanying illustration, may be equipped with a clamshell bucket or lifting magnet and used in the stock yard of a foundry.

CLAM SHELL OR LIFTING MAGNET MAY BE FITTED TO THIS EXCAVATOR



FINISHED THRUST WASHERS ARE USED AT THE ENDS

Makes Worm Box

The W. A. Jones Foundry & Machine Co., Chicago, has introduced a double thrust worm box. The box is designed to give a rigid support for the worm shaft and holds a good supply of oil, in which the worm operates. Finished thrust washers, consisting of two steel washers separated by one fiber, are provided at both ends. The bearings are babitted and bored and also faced on ends. The boxes are made in standard sizes to suit standard cut steel worms made by this company.

Contemplates Changing Style of Tuyeres

Question: We are preparing to reline our 72-inch cupola and are considering the advisability of using a single instead of a double set of tuyeres. There are so many divergent opinions held on the subject of tuyere area compared with melting zone area that we should appreciate your opinion on the subject. At present the cupola is provided with six tuyeres each 6 x 8½ inches and six lower tuyeres each 8 x 11½ inches. The ratio of the combined tuyere area to melting zone area is approximately 1 to 4¾. We cannot increase the number of tuyeres conveniently so will have to hold to six.

Answer: The usual approximate ratio of tuyeres to bottom area varies from 1 to 4 in small cupolas to 1 to 8 in large cupolas. As you say, a wide divergence of opinion exists among foundrymen as to the relative merits of single and double sets of tuyeres. Many cupolas provided only with single sets of tuyeres satisfactory iron and in other instances both upper and lower tuyeres are considered necessary.

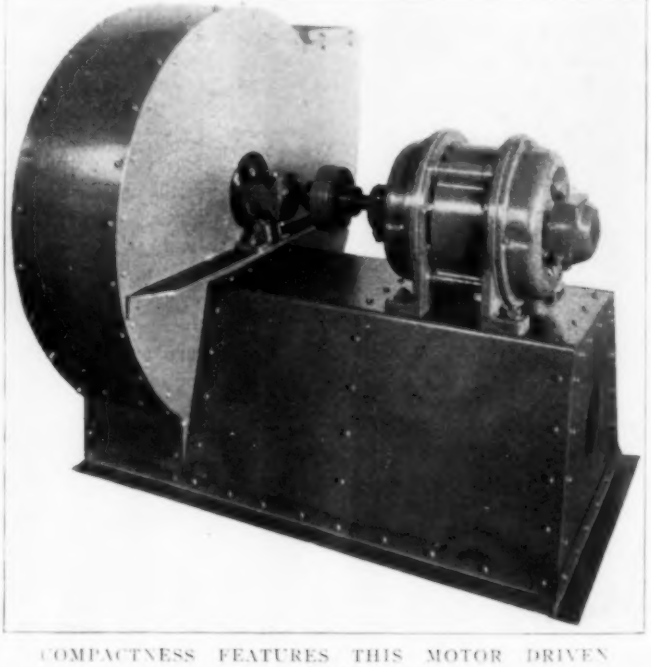
To a certain extent the weight and character of the charge constitutes a determining factor and again the length of time a cupola remains in blast has to be considered. As was pointed out previously a large foundry making automobile castings and operating a 72 and a 60-inch cupola uses only lower tuyeres, but the tuyeres are joined together and constitute a practically continuous opening into the cupola. It may interest you to know that in the new Ford foundry at River Rouge, Mich., a battery of Whiting cupolas each lined to 60 inches are operating with both upper and lower tuyeres. Of course the arrangement necessitates a comparatively high coke bed, but since the cupolas are in blast 8 hours at a time this factor does not amount to much so far as economical operation is concerned. Perhaps the most important factor in securing satisfactory melting conditions lies in arranging the relative volume of coke and iron in the charges so that melting takes place in a restricted zone.

You do not state whether your tuyeres are of the pendant type attached to a bustle pipe surrounding the cupola, or whether the wind box extends down to the base plate. In either instance it does not involve much labor or expense to enlarge the tuyere openings into the cupola. Assuming that pendant tuyeres are employed it only becomes necessary to cast a set of rectangular tuyeres 6 x 24 inches for the inside of the shell. Each tuyere to be provided on the outer end with a suitable connection on which to bolt the outlet of the pendant tuyere.

If the cupola is equipped with a wind belt extending down to the base plate the same type of tuyere may be employed with the exception that instead of providing a flanged outlet the tuyere casting can be made in the shape of a plain box with both ends open. In this case it will be necessary to enlarge the opening in the shell almost, or to the full size of the tuyere, 6 x 24 inches. A cupola lined to 72 inches has an area of 4072 inches. Six tuyeres 6 x 24 inches will aggregate 864 inches or an approximate area of 1 to 4¾. You will note that this corresponds closely with the present combined area of your upper and lower tuyeres. The circumference of a 72-inch cupola is 226 inches so that with six 24-inch tuyeres in place the space between each tuyere will be only 14 inches and this arrangement constitutes an almost continuous tuyere. Probably as many foundrymen favor a continuous tuyere as there are who prefer the individual tuyeres spaced at a considerable distance apart. Under proper charging conditions and with an adequate blast pressure and volume and under the supervision of a competent melter either type will produce satisfactory iron.

Exhaust Fan is Direct Motor Driven

A direct motor driven slow speed exhaust fan recently has been placed on the market by the Northern Blower Co., Cleveland. The housing for this fan is built of heavy steel plate. The sides are riveted to angles and the scroll sheet, which is removable, is fastened to the angles with screw caps. The wheels are built on a spider of heavy structural tee iron cast into the hub, and steel blades are riveted to the tee irons and to a cone shaped back plate. The bearings are self-aligning and self-oiling. Felt washers are fitted in grooves on each end of the bearing to keep out dirt and dust. The bearing is supported by the aligning bolt to knee brackets fastened to the pedestal and may be removed and rebabbited easily. A view of the fan and motor together with the manner in which one is operated by the other is shown in the accompanying illustration.



COMPACTNESS FEATURES THIS MOTOR DRIVEN EXHAUST FAN

Equipment Sales Are Light

Several Reasons Advanced for Decided Falling Off in Volume of Business—Feel That November Will See Betterment—Report of Sales of Foundry Supplies in 1923

CIRCUMSTANCES evidently are combining seriously to affect the volume of sales in the foundry equipment market. The general betterment in conditions noted late in the summer appears to have been halted, although manufacturers feel that the condition is only temporary. The foundry exhibition now being held in Milwaukee is given as the chief factor governing the slackened condition of the market, buyers holding off to gather ideas on equipment improvements. Other reasons which have been advanced are the political situation, and the abolition of the Pittsburgh-plus method of quoting prices. Price cutting is reported in several centers. Inquiries continue fair. Among the outstanding sales reported are a number of molding machines by the Herman Pneumatic Machine Co., Zelienople, Pa., sand mixers by the National Engineering Co., Chicago, sand-blast and dust-arrester equipment by the Pangborn Corp., Hagerstown, Md., the W. W. Sly Mfg. Co., Cleveland, and the Mott Sand Blast Mfg. Co., Chicago and core ovens by the Foundry Equipment Co., Cleveland.

Reports of the department of commerce show that establishments engaged primarily in the manufacture of supplies in 1923 reported a total output valued at $10,247,864, while foundry supplies manufactured as secondary products were valued at $541,145.

Delay Closing Until After Exhibition

THREE or four factors are combining at the moment to interfere with foundry equipment inquiries and sales in the Pittsburgh area. Some hesitancy on the part of buyers is attributed to concern over the outcome of the presidential election. Others find that the confusion in the steel market due to the abolition Sept. 22 of the Pittsburgh-plus method of quoting prices on steel products has had an adverse effect upon the placing of equipment orders in general, and of course foundry equipment orders are included. Chiefly however, the general postponement of buying is caused by the approaching foundry equipment show in Milwaukee. Some of the recent molding machine inquiries however, have turned into orders for the Herman Pneumatic Machine Co., Zelienople, Pa. The list includes the Pacific Sanitary Mfg. Co., Richmond, Cal., one large special bathtub molding machine; the Sivyer Steel Casting Co., Milwaukee, one rollover machine; Richardson & Boynton Co., Dover, N. J., three; Damascus Steel Casting Co., New Brighton, Pa., one; and the Canadian Westinghouse Co., Ltd., Hamilton, Ont., one. One or two interests in nearby districts are interested in electric furnaces and several cupola sales are in prospect but the general run of foundry equipment is moving slowly. Sales of small supplies keep up at a good pace and from time to time flask orders come through as does an occasional riddle, grinder or other small equipment. The W. W. Sly Mfg. Co., Cleveland, sold dust arrester equipment to the Vanadium Corp., Bridgeville, Pa., tilting sand blast mills and dust arrester equipment to the Falcon Bronze Co., Youngstown; and tumbling mills to the American Radiator Co., Buffalo. The Howard Stove Co., Beaver Falls, Pa., has purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md. The Pittsburgh Steel Car Co., Pittsburgh, has purchased a complete sand-blast outfit from the Mott Sand Blast Mfg. Co., Chicago, including dust arrester equipment, direct pressure machine and sand conveying machinery. The Lawler Iron Works, Gull and Ferry streets, Buffalo, and the Jones Foundry Co., Watsontown, Pa., both suffered losses through fires recently and in rebuilding may require more equipment. A contract has been placed for an addition to the plant of the Howard Stove Co., Beaver Falls, Pa., which operates a foundry and this may necessitate the purchase of additional equipment. It is understood that equipment orders will soon be placed by the Chase Foundry & Mfg. Co., Columbus and the Modern Foundry Co., Oakley, Cincinnati, O., which are erecting additions. Enameling department equipment is being purchased by the Topton Foundry Co., Topton, Pa. The Pittsburgh Plate Glass Co., Creighton, Pa., operating a foundry for the manufacture of glass molds, placed orders with the Alliance Machine Co., Alliance, O., for 3 cranes.

Slackening Noted in West

MANUFACTURERS of foundry equipment believe the foundry show at Milwaukee was responsible for a decided slowing up in receipt of both orders and inquiries late in September and early in October. Foundrymen proposing to modernize or enlarge plants appeared to be delaying until they could view equipment first-hand at Milwaukee. Among recent sales of its sand mixers by the National Engineering Co., Chicago, has been one to Francis Keil & Sons, Inc., New York. The National Car Coupler Co., Attica, Ind., has bought sand-blast and dust-arrester equipment and the Crown Foundry Co., Peoria, Ill., has secured sand-blast equipment from the Pangborn Corp., Hagerstown, Md. The Moline Iron Works, Moline, Ill., has purchased tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland, and the Griffin Wheel Co., South Tacoma, Wash., and the Capitol Brass Works, Detroit, have bought cinder mill equipment from the same manufacturer. The Chicago Steel Foundry Co., Chicago, has ordered a sand-blast cabinet with 8-foot diameter turntable complete with dust arrester and fan from the Sly company.

Eastern Business Light

SELDOM at this season of the year has foundry equipment buying in the eastern district been at a lower ebb. Virtually no demand is noted for equipment for new projects or extensions, which accounts chiefly for the scarcity of sizable lists. A general attitude of hesitancy prevails among buyers for replacement purposes. Unquestionably equipment business is developing more slowly than the trade generally expected a month or so ago. Despite expressions of confidence in various quarters as to the outcome of the election this fall, the political situation undoubtedly is contributing substantially to this un-

certainty. Also, some sellers state that during the early part of the month some business was held up, pending the American Foundrymen's association's exhibition in Milwaukee, Oct. 11-16, prospective buyers preferring to see what might be shown in the way of new mechanical developments before taking action. As a result of this dullness, competition has been keen, it being essentially a buyer's market. This is particularly noticeable in conveying equipment, where shading is in evidence. Demand for supplies has improved with the increase in operations, but there the improvement appears to have stopped. Included in scattered orders is a 2-ton cupola charger for the International Motor Co., New Brunswick, N. J., this business going to the Shepard Electric Crane & Hoist Co., Montour Falls, N. J. The J. P. Ward Brass & Iron Foundry Co., Elmira, N. Y., has purchased tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland. The American Schaeffer & Budenberg Co., Boston, has bought a sand-blast installation from Pangborn Corp., Hagerstown, Md.

Buying Is Delayed

SLACK business conditions in the equipment market in the Cleveland territory, as noted in the issue of Oct. 1, have continued during the past two weeks. Manufacturers, who a month or two ago were experiencing a betterment in the volume of sales, now find few buyers willing to close on the inquiries out. A variety of reasons are advanced for this condition in the market, the chief being the political situation and the exhibition of equipment in connection with the convention of the American Foundrymen's association, which now is being held in Milwaukee. Users of equipment, planning installations in the near future are holding off until after the show to examine new improvements that may be shown. Manufacturers anticipate an increase in business in November.

The Westinghouse Air Brake Co., Wilmerding, Pa., has ordered 21 core ovens from the Foundry Equipment Co., Cleveland. Fifteen of these ovens will be of the double rack type and six of the rolling drawer type. Fifty steel core racks also will be furnished by the same company. The Putnam Foundry Machine Co., Putnam, Conn., and the Deming Co., Salem, O., have purchased tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland. The American Radiator Co., Buffalo, has closed on a dust arrester installation from the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Southern railway contemplates constructing a foundry at its repair shops in Washington, D. C.

The Bahnke-Reilan Co., Red Wing, Minn., is contemplating constructing 1-story, brick foundry building. Albert H. Bahnke, St. Paul, is interested in the company.

Acme Brass Co., 8211 Collins street, Hamtramck, Detroit, was damaged by fire recently with most of the loss being confined to the furnaces.

Ballwood Pipe Co., Clifton, N. J., plans constructing 1-story, 44 x 172-foot foundry on Central avenue. W. G. Pattison, 625 Main avenue, Clifton, is architect.

Victor Stove Co., 208 Depot street, Salem, O., plans constructing 2-story addition to its plant to replace that recently damaged by fire. The company operates a gray iron foundry.

The Topton Foundry Co., Topton, Pa., has completed plans for erecting a 150 x 200-foot plant addition to be used as an enameling department.

Jones Iron Foundry Co., Watsontown, Pa., manufacturer of gray iron, brass and aluminum castings, plans rebuilding portion of its plant recently damaged by fire.

The Robervale Foundry Co., Robervale, Que., was damaged badly by fire with loss to building and equipment. It is expected that reconstruction will start without delay.

American Radiator Co., Buffalo, N. Y., has awarded the Wendnagel Co., general contract for constructing plant addition at Litchfield, Ill. *Noted Sept.* 15.

Shelton Bros., Paducah, Ky., have awarded contracts to Vandervelde & Augustus, for a plant addition to double its present capacity. Harry Jamieson is architect. The Shelton company operates a gray iron foundry.

The Whiting Corp., Harvey, Ill., plans constructing 1-story, 75 x 75-foot steel frame power house. J. H. Whiting, 53 West Jackson boulevard, Chicago, is president. T. D. Hobson & Son, Harvey, are general contractors.

N. O. Nelson Mfg. Co., St. Louis, plans establishing a plant at Little Rock, Ark., for production of plumbers supplies. L. D. Lownin, St. Louis, is president of the company, and Harry E. Shauman, manager at Little Rock.

Regent Stove Co., Wyandotte, Mich., manufacturer of stoves and operator of a gray iron foundry, was damaged by fire recently with heavy loss. Thomas H. Conway, president, claims losses to be covered by insurance and that reconstruction will commence shortly.

Chattanooga Foundry & Roofing Co., Chattanooga, Tenn., has been incorporated for $175,000 to own and operate a foundry and manufacture metal products, by J. J. Gallagher, O. P. Hanson, J. J. Gallagher Jr., M. Butler and W. B. Swaney.

Canada Valve & Hydrant Co., Ltd., Brantford, Ont., has been incorporated to acquire the plant and business of the Canada Valve & Hydrant Co., to manufacture hydrants, valves and other products, by Edward F. Roberts, Henri K. Jordan, Willoughby S. Brewster.

Reed Roller Bit Co., 3602 Harrisburg boulevard, Houston, Tex., is remodeling the plant of the Mack Mfg. Co., Mack street and Houston Belt & Terminal tracks, that city. A foundry, machine shop and forge shop, used by the Mack company are the buildings to be remodeled. *Noted Oct.* 1.

Eastern Malleable Iron Co. has awarded contracts to the Berlin Construction Co. for erecting a plant in New Britain, Conn., for its subsidiary, the Vulcan Iron Works, Lawrence & Coe Construction Co., 372 Trumbull street, Hartford, Conn., are general contractors. *Noted Sept.* 15.

Hill & Griffith Co., Cincinnati, manufacturer and distributor of foundry facings and supplies, has awarded the Austin Co., Chicago, construction contracts for plant at 4046 West Sixteenth street, Cicero, Ill. All materials will be purchased through the Chicago office of the Austin Co.

The Crane Co., 836 South Michigan avenue, Chicago, manufacturer of valves and operator of foundries, has purchased the plant at 710 Windsor street, Hartford, Conn., of the National Iron Works. The latter company will retain its equipment for use in a plant to be constructed.

Hamburg Foundry Co., Second and Washington streets, Reading, Pa., has purchased the plant of the Bernstein Foundry at Third street and Allegheny avenue. The two will be consolidated under the name of Fairmount Foundry Co., Inc. L. K. Saul was one of the organizers of the Hamburg company.

Union Smelting & Refining Co., St. Charles street, Newark, N. J., subsidiary of the Federated Metals Co., New York, has awarded contracts to the Austin Co., 217 Broadway, the latter city, for constructing 1-story, brick, steel and concrete ingot warehouse. Two 1-story foundries also will be constructed.

Atchison chamber of commerce, Atchison, Kans., is handling the sale of a plant in that city consisting of a sheet metal foundry building, 120 x 350 feet, a large amount of general foundry equipment, with a melting capacity of 50 tons daily. The plant includes a fully equipped machine shop, brass foundry, warehouse and modern office.

New Trade Publications

GEARS—Standardized gears as a means for saving costs by the elimination of special forms are advocated by the Boston Gear Works Sales Co., Quincy, Mass. Ability to replace readily from stock is an advantage of prime importance. The various new forms of gears recently added to its list are illustrated.

ACETYLENE—In three small pages the International Oxygen Co., Newark, N. J., has compressed a wealth of information as to the use of acetylene. It is a valuable reference to safe practice and also informative as to the source and nature of the gas.